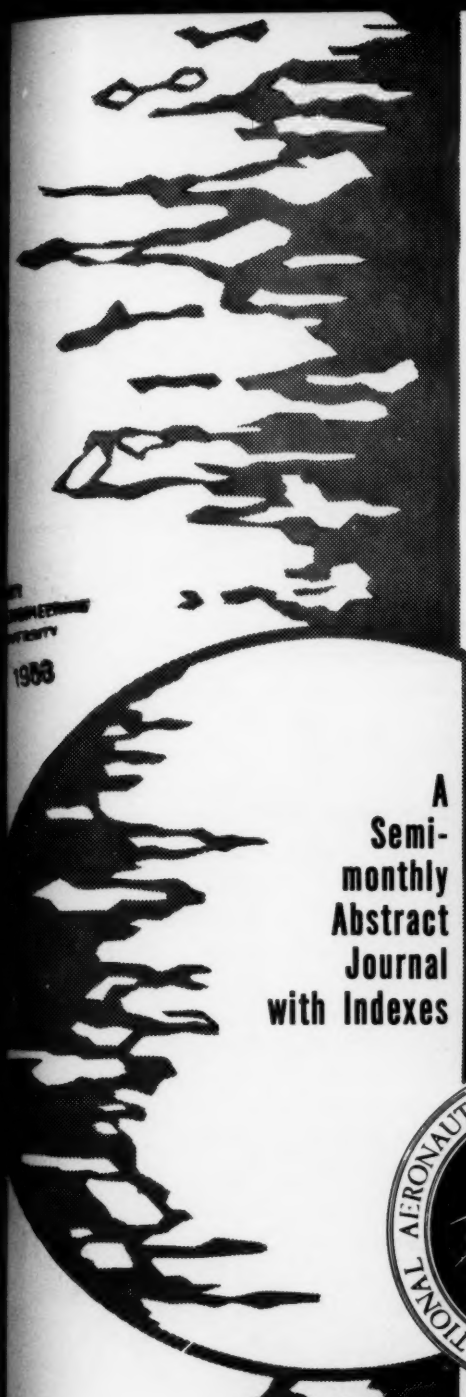

Scientific and Technical Aerospace Reports

A Semi-monthly Abstract Journal with Indexes

July 23, 1963

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Includes: management; space law and legal matters; symposia or conferences of a broad or a general nature.

N63-16627 Smithsonian Astrophysical Observatory, Cambridge, Mass.

PROCEEDINGS OF THE SYMPOSIUM ON THE ASTRONOMY AND PHYSICS OF METEORS, HELD AT SMITHSONIAN ASTROPHYSICAL OBSERVATORY, CAMBRIDGE, MASSACHUSETTS, AUGUST 28-SEPTEMBER 1, 1961

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(Sponsored by Smithsonian Astrophys. Obs. and AFCRL)

(*Its* Contrib. to Astrophys., v. 7) GPO: $2.75

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N63-16801 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PROGRESS REPORT NO. 3 ON STUDIES IN THE FIELDS OF SPACE FLIGHT AND GUIDANCE THEORY [JUNE 15-DECEMBER 20, 1962]

E. D. Geissler Feb. 6, 1963 226 p 58 refs

(NASA TM X-50077; MTP-AERO-63-12) OTS: $15.00 ph, $6.98 mf

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N63-16812 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

ATMOSPHERIC TURBULENCE AND ITS RELATION TO AIRCRAFT. PROCEEDINGS OF A SYMPOSIUM HELD AT THE ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH, 16TH NOVEMBER 1961

M. J. Lighthill et al London, HMSO, 1963 284 p 199 refs

Available from HMSO: £1 10s

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N63-16854 Air Force Missile Development Center, Holloman AFB, N. Mex.
PROCEEDINGS OF THE AFMDC INERTIAL GUIDANCE TEST SYMPOSIUM, VOLUME I, HOLLOMAN AIR FORCE BASE, 16-17 OCTOBER 1962
Marvin C. Green [1962] 293 p 78 refs
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02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors and Control Surfaces; and 11 Fluid Mechanics.

N63-16358 Brown U. Div. of Applied Mathematics, Providence, R.I.
FLOW BETWEEN CONCENTRIC ROTATION CYLINDERS—A NOTE ON THE NARROW GAP APPROXIMATION Technical Report
F. E. Bisshopp Apr. 1963 17 p 1 ref
(Contract Nonr-562(07))
(Rept. 562-(07)51)

A systematic survey of narrow gap limits is presented in which the ratio of the separation of the two cylinders to a characteristic radius approaches zero and is not uniquely defined, but rather the form of the resulting governing equations depends upon the manner in which the passage to the limit is made. This presentation is made in conjunction with carrying out the deviations of conditions under which steady flow between concentric rotating cylinders becomes unstable to perturbation of infinitesimal amplitude, within the framework of the narrow gap approximation in which the separation of the two cylinders is presumed to be much smaller than either radius. I.v.L.

N63-16372 Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge
THE DESIGN AND INITIAL OPERATION OF A MAGNETIC MODEL SUSPENSION AND FORCE MEASUREMENT SYSTEM [Interim Technical Report, Feb. 1960-May 1962]
Edward Lee Tilton, III, William J. Parkin, Eugene E. Covert, James B. Coffin and John E. Chrisinger Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Jan. 1963 145 p 61 refs
(Contract AF 33(616)-7023)
(ARL-63-16)

The design, construction, and proof tests of a magnetic-model-suspension system capable of use in a M = 4.8 wind tunnel are described. The results indicate that the model can be suspended magnetically during the wind tunnel starting conditions, that the model can be angulated, and lift and drag forces measured with the model at angle-of-attack. Author

N63-16403 Directorate of Engineering Test, Aeronautical Systems Div., Wright-Patterson AFB, Ohio
INVESTIGATION OF FLOW VARIABLES OVER A SERIES OF REARWARD FACING STEPPED FLAT PLATES AT A NOMINAL MACH NUMBER OF 4.15 [Final Report]
Richard R. Smith Apr. 1963 80 p 8 refs
(ASD-TDR-63-131)

A study was made of the aerodynamic characteristics over a flat plate with basic changes in the flow field imposed by geometric and aerodynamic means. Pressure distributions and schlieren photographs were used to show the effects of (1) leading-edge bluntness, (2) rearward-facing step, (3) rearward-facing step with gas ejected from the vertical face of the step, and (4) a control surface. Although three-dimensional effects were large at high angles-of-attack, the flat-plate results correlated well with theory and other experimental data. The effects of leading-edge bluntness, step height, and ejection angle are small. The effect of gas ejection, in the manner tested, is not sufficient to produce the effect of a physical control surface. Author

N63-16425 National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
TABLES OF AERODYNAMIC COEFFICIENTS OBTAINED FROM DEVELOPED NEWTONIAN EXPRESSIONS FOR COMPLETE AND PARTIAL CONIC AND SPHERIC BODIES AT COMBINED ANGLES OF ATTACK AND SIDESLIP WITH SOME COMPARISONS WITH HYPERSONIC EXPERIMENTAL DATA
William R. Wells and William O. Armstrong Washington, NASA, 1962 277 p
(NASA TR R-127) GPO: $2.25

Closed-form expressions and tables composed from them are presented for complete and partial conic and spheric bodies at combined angle-of-attack and sideslip in Newtonian flow. Aerodynamic coefficients of these bodies are tabulated for various body

segments over a range of angles-of-attack from 1° to 85° and angles-of-sideslip from 0° to 15°. Some comparisons between Newtonian predictions and hypersonic experimental aerodynamic characteristics were made for conic bodies having various surface slopes, nose bluntnesses, and body cross sections to indicate the range of validity of the theory. In general, the theory is shown to agree quite well with experimental results for sharp-nose complete cones and for configurations having large blunted noses and steep surface slopes. However, agreement between theory and experiment generally is poor for the more slender, slightly blunted complete or half conic bodies and also sharp-nose half conic bodies where real-flow phenomena such as forebody interference, viscous forces, leeward surface contributions, or leading-edge pressure reductions may have significant effect. The agreement between theory and experiment for the bodies considered can be improved by using the stagnation-pressure coefficient behind a normal shock rather than 2 as the Newtonian coefficient, although for the sharp-nose half conic bodies there is no theoretical justification for this modification. Author

N63-16427 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SOME EFFECTS OF SIMULATED BENDING AND FOURTH-STAGE SIZE ON LOCAL PRESSURES AND NORMAL-FORCE DISTRIBUTIONS OF A MODEL OF A SCOUT CONFIGURATION AT A MACH NUMBER OF 3.10

Byron M. Jaquet Washington, NASA, May 1963 57 p 7 refs (NASA TN-D-1799) OTS: $1.50

A wind-tunnel investigation was made at a Mach number of 3.10 to determine the effects of simulated body bending and size of the fourth stage on the normal-force distributions of a 0.02655-scale model of the Scout research vehicle. Pressures were measured, with the straight-center-line model, on a 13° base flare and on the horizontal-tail panels with and without the base flare. Normal-force, axial-force, and pitching-moment coefficients were determined for a straight-center-line model of the Scout with and without the base flare and fourth-stage modifications. Most of the tests were conducted for a Reynolds number per foot of 23.4×10^6. It was found that body bending primarily affected the normal-force distribution at an angle-of-attack of 0° although there was some effect of body bending on the variation of the normal-force distribution with angle-of-attack. (There were many regions along the body in which loadings were not measured.) An increase in cone angle and size of the fourth stage increased the local normal-force coefficient as would be expected. The pressures on the horizontal tail were affected to a large extent by the addition of the base flare. The flare under certain conditions doubled the pressure coefficient and appeared to cause an outward and forward shift in the tail center of pressure. Pressures on the flare were generally highest near the horizontal-tail panels. Total force and pitching-moment coefficients were found to be affected more by the addition of the 13° base flare than by fourth-stage modifications of the straight model. Since the data were obtained on the bent-center-line model with a mode-shape deflection magnified by a factor of 20, the significance of the changes in normal-force distribution due to body bending cannot be assessed without a dynamic analysis of the vehicle along the launch trajectory. Author

N63-16583 Royal Netherlands Aircraft Factories Fokker, Amsterdam

ON THE INFLUENCE OF DIHEDRAL ON LATERAL DYNAMICS INVESTIGATED ON THE F-27 PROTOTYPE

P. de Boer [1962] 14 p Presented to the Fifth European Aeron. Congr., Venice, Sept. 12–15, 1962

The F-27 prototype was flown with artificially increased wing dihedral setting, using a servosystem capable of deflecting the ailerons in proportion to the angle of sideslip. Several dihedral settings were tried out in conditions for cruise and for power approach with different flap settings, and a survey was obtained of pilots' opinions on the degree of acceptability of every setting. Worthwhile general information was collected concerning permissible dihedral levels and the beneficial effect on the rate of spiral divergence of possible increases over the normally applied dihedral level. Author

N63-16754 General Electric Co. Light Military Electronics Dept., Utica, N.Y.

THE RELATIONSHIP OF MEASURED VIBRATION DATA TO SPECIFICATION CRITERIA

R. C. Kroeger and G. J. Hasslacher, III *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 49–63 9 refs This paper was not presented at Symp. (See N63-16750 14-01)

The highlights of a successful vibration-data measurement program—from sensor selection and evaluation to data processing—are reviewed. Time-sampled data from missile flights are analyzed, and various errors attendant to spectral analysis are considered. Unique methods of data presentation are discussed also. Finally, the respective accuracies of the data analyses are compared, and the impact of these data on design specifications is noted. Author

N63-16755 Aberdeen Proving Ground. Development and Proof Services, Md.

PREPARATION AND ANALYSIS OF MUNSON ROAD-TEST TAPES FOR LABORATORY VIBRATION TESTS

R. D. Baily and J. W. Apgar *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 64–76 2 refs (See N63-16750 14-01)

A program to correlate the vibration requirements for vehicular mounted equipment in the Air Force's MIL-E-4970 program with the vibration experiments conducted on the Munson test course is described. The composite tape loops are found to be representative of the maximum conditions for the courses, and are useful in statistical studies and programing wave vibration equipment. The Munson tests are found to compare with the common 8000-mile cross-country tests. D.E.R.

N63-16761 Lockheed Missiles and Space Co., Sunnyvale, Calif.

AN APPROACH TO POLARIS FLIGHT SHOCK SIMULATION BY ELECTRODYNAMIC SHAKER

Henry J. Schwabe *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 144–163 2 refs (See N63-16750 14-01)
(Contract NOrd-17107)

This paper describes the initial use of electrodynamic shakers to simulate black-box transients in the POLARIS flight environment. The results indicate the measure of success in generating arbitrary pulse shapes. The shaker responses obtained by photographic time-plots were free of distortion, and were repeatable in all aspects. Author

N63-16821 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

GUST LOADS ON AIRCRAFT

N. I. Bullen *In its* Atmospheric Turbulence and its Relation to Aircraft. Proc. of a Symp. held at R.A.E., Farnborough, Nov. 16, 1961 1963 p 195–240 31 refs (See N63-16812 14-01) HMSO: £1 10s

The need for gust-load measurements on aircraft, both for fatigue calculations and for limit-load determination, is discussed, and the development of the counting accelerometer for this purpose is outlined. The method of analyzing the data using the "discrete gust" concept, its limitations, and its relation to present requirements, are examined. A review is made of the information at present available, both from counting-accelerometer data collected in this country, and from the V-g-h data in the U.S.A., and the main results and conclusions are summarized. Author

N63-16822 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
AIRCRAFT RESPONSE TO TURBULENT AIR
J. Burnham *In its* Atmospheric Turbulence and its Relation to Aircraft. Proc. of a Symp. held at R.A.E., Farnborough, Nov. 16, 1961 1963 p 241-256 9 refs (See N63-16812 14-01) HMSO: £1 10s

A comparison is made between the "discrete gust" and spectral methods of assessing aircraft response to atmospheric turbulence. Using the limited information at present available on the spectrum of the vertical component of atmospheric turbulence, it is shown that the way in which load histories experienced by different aircraft are related is essentially the same in the spectral as in the discrete-gust approach. Author

N63-16828 Aeronautical Research Labs., Melbourne (Australia)
BLOCKAGE INTERFERENCE IN A SLOTTED WALL TUNNEL
W. W. Wood June 1962 23 p 4 refs
(ARL/A. 123)

Subsonic interference is considered for tunnels with longitudinally slotted walls and narrow, closely spaced slots. A nonlinear inviscid treatment of the flow near the slots is given, appropriate to larger interference velocities than those for which linear theory is valid. An effective boundary condition is derived which is applicable uniformly over the slotted wall, and the corresponding two-dimensional interference determined for an airfoil midway between parallel slotted walls. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N63-16350 California Inst. of Tech. Div. of Engineering and Applied Science, Pasadena
FLOW PAST A PARTIALLY CAVITATING CASCADE OF FLAT PLATE HYDROFOILS
R. B. Wade Jan. 1963 65 p
(Contract Nonr-220(24))
(E-79-4)

The nonviscous, steady-cavitating, two-dimensional flow through a cascade of flat plate hydrofoils, under the usual assumptions of incompressibility and irrotationality, is reviewed. The motivation for this investigation is the present day interest in the high-speed performance of lifting surfaces, such as in hydroplane boats and the behavior of the propellers operating under cavitating conditions. A linearized theory is presented for the partial cavitation in a cascade of flat plates. The results are presented in such a way that they may be useful as a guide in the design of turbomachines and other applications. From the results it is possible to determine the cavity length, lift coefficient, and downstream conditions for any desired cavitation condition for a given specific cascade geometry and initial upstream conditions. The limitations of the theory are discussed and it is shown that the cascade effect diminishes the singular behavior at the end of the cavity. In the case of the isolated foil, the theory holds good up to a ratio of cavity length to chord length of approximately 0.74, whereas in the cascade flow this ratio varies from about 0.8 for small solidities up to 0.95 for larger solidities. It is further shown that for solidities of 0.5 and over, the cascade effect is appreciable and cascade interference cannot be neglected in this range. However, for solidities smaller than 0.5, the cascade effect is relatively small and the isolated case may be used as a fairly good approximation, provided the mean conditions are taken as reference quantities. I.v.L

N63-16415 Aeronautical Research Council (Gt. Brit.)
THE EFFECT OF SKIN TAPER ON THE AEROELASTIC PROPERTIES OF WINGS
J. A. Rein London, HMSO, 1963 40 p 11 refs
(ARC-CP-642; supersedes RAE-R-STRUCT-264; ARC-22983)
Available HMSO: 5s 6d

An analysis is made of the effect of linear variation of the spanwise skin thickness on the divergence, flutter, and aileron reversal speeds of thin wings. It is shown that for rectangular wings, a skin thickness tapering from root to tip produces an increase of up to 8% in the critical speeds, whereas an inverse taper results in a reduction of up to 14%. For a tapered wing, skin thickness tapering from root to tip results in a reduction in the critical speeds of up to 7%. A comparison is made between the results obtained from the analysis and from some flutter speed criteria. The effect of skin taper on the mode of distortion and on the dynamic torsional stiffness is investigated. Author

N63-16428 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC EFFECTS OF MODIFYING WING INBOARD TRAILING-EDGE CAMBER OF A MODEL AT HIGH SUBSONIC SPEEDS
Richard J. Re Washington, NASA, May 1963 44 p 5 refs
(NASA TN-D-1809) OTS: $1.25

An investigation has been made to determine the effect of a modification in the effective camber of the inboard wing sections near the trailing edge on the longitudinal aerodynamic characteristics of a model. The wing had discontinuous sweep at the leading edge, with quarter-chord sweep of 40° on the outboard portion. The wing was modified near the trailing edge so that the camber lines near the body were reflexed and merged with the original camber lines at the midsemispan. The wing was tested with contoured, cylindrical, and modified cylindrical body configurations. The contoured body configuration was tested with and without horizontal and vertical tails. The Mach number of the test ranged from 0.40 to 0.96 and the angle-of-attack ranged from −5° to 15°. Reynolds number per foot varied from 2.6×10^6 to 4.4×10^6. The modified wing trailing edge generally reduced the drag coefficient at low lift coefficients, but increased the drag coefficient in the range of lift coefficients for maximum lift-drag ratio, and resulted in lower values of maximum lift-drag ratio. The modification alleviated model pitch-up which occurred at a lift coefficient of about 0.45 at Mach numbers of 0.92, 0.94, and 0.96. In addition, the modified trailing edge increased the model angle-of-zero lift about 1° at all Mach numbers, and decreased the model pitching moment at zero angle-of-attack at all Mach numbers below 0.96. Author

N63-16747 General Dynamics/Pomona, Calif.
RESULTS MRT OSCILLATING TAIL HIGH SPEED WIND TUNNEL TEST
G. E. Padgett and P. W. Abbott Nov. 12, 1962 77 p 9 refs
(Contract NORD-16840)
(TM-348-33.6-11)

Tests were conducted at the Convair high-speed wind tunnel, San Diego, California, in August and September 1962, to investigate the relative phase of aerodynamic forces and panel position for forced oscillations of a Tartar/Terrier tail fin. The tests were conducted for a Mach regime of 0.5 to 1.5. The test technique, data-reduction scheme, and results of the tests are presented. In addition, dynamic design information for the adaptive control system is presented. Author

N63-16797 National Physical Lab. Aerodynamics Div., Teddington, (Gt. Brit.)
N. P. L. AEROFOIL CATALOGUE AND BIBLIOGRAPHY
R. C. Pankhurst London, Ministry of Aviation Mar. 1962 25 p 136 refs
(NPL-R&M-3311) HMSO: 10s

This report catalogs airfoils which have been designed (or substantially modified) at the N.P.L., and which have been the subject of theoretical investigations, aircraft design studies, or wind-tunnel tests. A full bibliography is included. Author

04 AIRCRAFT

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N63-16430 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FULL-SCALE WIND-TUNNEL TESTS OF A MEDIUM-WEIGHT UTILITY HELICOPTER AT FORWARD SPEEDS
John L. Mc Cloud III, James C. Biggers, and Ralph L. Maki Washington, NASA, May 1963 31 p 8 refs
(NASA TN-D-1887) OTS: $0.75

Tests were conducted with the rotor on and off at speeds from 80 to 130 knots at various fuselage attitudes, and the lift, drag, pitching-moment, and power data are presented. The power data are discussed in terms of the rotor-off fuselage force data, and the wind-tunnel data are compared both with flight-test and computed rotor data. Author

N63-16456 Advisory Group for Aeronautical Research and Development, Paris
GROUND EFFECT MACHINES
T. D. Earl and Wilbur C. Nelson (Michigan U.), ed. Jan. 1962 164 p 128 refs
(AGARDograph-67)

A study is made of the problems and controlling parameters in the application of annular jet and other new ground effect techniques to aircraft and to the design of ground and waterborne craft. Author

N63-16471 Martin Co., Orlando, Fla.
RECIRCULATION PRINCIPLE FOR GROUND EFFECT MACHINES MAN-CARRYING TEST VEHICLE: PRELIMINARY FLIGHT TEST RESULTS Final Report
P. Vinson Ft. Eustis, Va., Army Transportation Res. Command, Dec. 1962 63 p 3 refs
(Contract DA-44-177-TC-710)
(TCREC-TR-62-100)

Results are given of an experimental investigation of hovering performance and stability and control characteristics of a ground effect machine. The feasibility of obtaining lift by utilizing the recirculating ejector concept was proven. Author

N63-16533 Royal Netherlands Aircraft Factories Fokker, Amsterdam
RESULTS OF RATIONAL LANDING LOAD CALCULATIONS IN THE LIGHT OF PRESENT AIRWORTHINESS REQUIREMENTS
J. Yff 1962 17 p 8 refs Presented to the Fifth European Aeronautical Congress, Venice, Sept. 12–15, 1962

Results of a comprehensive, rational, dynamic landing-load analysis of a high-wing aircraft equipped with pylon tanks, which is subjected to the most severe combination of true initial landing conditions that could be derived from known statistical data, are presented and compared with results of landing-load calculations based on present day airworthiness requirements. It is found that when dynamic effects are taken into account, the airworthiness requirements yield very conservative results, while neglecting dynamic effects severely underestimates wing loads, especially torsional moments. The degree of sophistication which is needed in a rational analysis in order to predict "true" landing loads has been investigated by studying the influence of the number of elastic degrees of freedom, of the aerodynamic forces due to wing motion, of the neglect of the unsprung mass, and of the way in which the friction coefficient has been taken into account. Author

N63-16767 Martin Co., Orlando, Calif.
FLIGHT DYNAMIC EVALUATION OF THE BULLPUP B MISSILE
L. W. Hodge *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 202–215 (See N63-16750 14-10)

The purpose of this paper is to summarize the available flight data and the analyses which were made to establish the maximum BULLPUP B component shock, vibration, and steady-acceleration requirements for specification comparisons and design purposes. Author

N63-16823 Air Registration Board, London (Gt. Brit.)
ATMOSPHERIC TURBULENCE CONSIDERATIONS IN CIVIL AIRCRAFT AIR-WORTHINESS
Walter Tye *In* Aircraft Establishment, Farnborough (Gt. Brit.) Atmospheric Turbulence and its Relation to Aircraft. Proc. of a Symp. held at R.A.E., Farnborough, Nov. 16, 1961 1963 p 257–276 (See N63-16812 14-01) HMSO: £1 10s

The purpose of this paper is to give some idea of the present state-of-the art in designing aircraft to take turbulence into account, and to underline the turbulence problems which appear to need the most urgent attention from the civil-airworthiness engineer's viewpoint. The structural implications are mainly discussed, but some reference is made to examples of the effects of turbulence on the necessary handling qualities of airplanes and on their performance. Author

N63-16876 National Aeronautical Establishment. Flight Research Section, Ottawa (Canada)
THE MODEL CONTROLLED METHOD FOR THE DEVELOPMENT OF VARIABLE STABILITY AIRCRAFT Internal Report
D. G. Gould June 1962 46 p 11 refs
(LR-345)

The application of a technique described as the model controlled method (termed adaptive or semiadaptive when applied to autopilots) for providing aircraft with variable stability and control characteristics is described. The development of a variable-stability helicopter using this method is treated in some detail to illustrate the significant design parameters, and to demonstrate the advantages of the method over the more customary approach.
Author

N63-16882 Aeronautical Research Council (Gt. Brit.)
MEASUREMENTS OF THE MOMENTS OF INERTIA OF THE AVRO 707B AIRCRAFT
D. H. Perry London, HMSO, Aug. 1961 33 p 21 refs
(ARC-CP-647; supersedes RAE-TN-AERO-2778; ARC-23439)
Available from HMSO: 5s

Measurements have been made of the pitching, rolling, and yawing moments of inertia of the Avro 707B aircraft, using the spring constrained oscillation method. Satisfactory results were obtained for the empty aircraft, but some interference effects were observed when the fuel tank was partially filled. Attempts to measure the orientation of the principal inertia axes were unsuccessful because the measuring frequency lay close to the frequency of one of the natural rolling modes of the equipment. The inertia measurements are compared with estimates which had been made from the weight schedule of the aircraft. Dynamic flight measurements of the lateral derivative n_v, which had been analyzed using these estimated inertias, showed a discrepancy with steady-state flight measurements. This discrepancy was largely resolved when the measured moments of inertia were used in the analysis. Author

N63-16897 Chance Vought Corp. Vought Aeronautics Div., Dallas, Tex.
STATIC STABILITY TESTS ON A 0.098 SCALE STANDARD LAUNCH VEHICLE (SLV)-1B WITH A 4-SQUARE-FOOT FIN AREA
C. E. Ziegler Kirtland AFB, N. Mex., Test Directorate, Feb. 1963 126 p 3 refs
(Contract AF 29(601)-5603)
(AFSWC-TDR-63-21)

The model was instrumented with a six-component internal strain-gage balance and two base-pressure probes to determine the forces on the model. The model was then placed in the tunnel and tested in the Mach-number range of 0.6 through 5.0, and a Reynolds-number range of 6 million/ft. to 20 million/ft. The model attitude was varied from −10° to +10° in the pitch plane. The results obtained were force and moment data in the body axes; these results are presented in tabulated form with selected coefficients presented in plotted form. Author

N63-16942 Aberdeen Proving Ground. Ballistic Research Labs., Md.
SUMMARY REPORT ON STRONGARM ROCKET MEASUREMENTS OF ELECTRON DENSITY TO AN ALTITUDE OF 1500 KILOMETERS
Spence T. Marks, Charles E. Shafer, William J. Cruickshank, Raymond E. Prenatt, and George A. Dulk Jan. 1963 99 p 25 refs
(BRL-1187)

A summary report is presented which covers all phases of a project for the measurement of electron density to an altitude of 1500 kilometers by employing a five-stage solid-propellant rocket combination known as the Strongarm, and a two-frequency propagation experiment. Included in the report are sections which describe the theory applicable to the measurements, the rocket vehicle, the airborne instrumentation, the ground instrumentation, the vehicle performance, and the experimental results. An early-morning electron density profile to an altitude of 1500 kilometers is presented, together with a daytime and a nighttime profile to 650 kilometers. A model of the ionospheric inhomogeneities which existed during the daytime rocket flight is given. Scale heights and exospheric temperatures derived from the profiles are also presented and discussed.
Author

05 ASTRONOMY AND ASTROPHYSICS

Includes: celestial mechanics; and radioastronomy.

For related information see: 12 Geophysics; and 29 Space Sciences.

N63-16482 General Motors Corp. Aerospace Operations Dept., Santa Barbara, Calif.
METEOROID IMPACT
C. J. Maiden Apr. 1963 89 p 63 refs
(TM-63-203)

This article discusses protection of spacecraft against meteoritic particles, the damage meteoroid impact can inflict upon a structure, and the properties of meteoritic particles applicable to spacecraft designers. Included are discussions on meteoritic debris, hypervelocity projection techniques, damage due to hypervelocity impact, the meteor bumper, and designing against the meteoroid hazard. N.E.A.

N63-16628 Royal Radar Establishment, Malvern (Gt. Brit.)
LIMITATIONS OF RADAR TECHNIQUES FOR THE STUDY OF METEORS
J. S. Greenhow *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 5–17 19 refs (See N63-16627 14-01) GPO: $2.75

The basic theories on the scattering of radio waves from the ionized trails produced by meteors are reviewed. The height variation of trail radius, attachment function, and meteor velocity and radar observations of bright meteors are discussed. It is shown that much of the previous work on the determination of linear electron densities in meteor trails, and the measurements of meteor mass distributions and upper atmospheric pressures and scale heights, is in error. N.E.A.

N63-16629 Kharkov Polytechnical Inst. (USSR)
THE INITIAL RADIUS OF IONIZED METEOR TRAILS
B. L. Kashcheyev and V. N. Lebedinets *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 19–22 5 refs (See N63-16627 14-01) GPO: $2.75

A theory is proposed for calculating the initial radius of ionized meteor trails. The initial radius of an ionized meteoric trail can be determined by simultaneous radio-echo observations at two different wavelengths. From the ratio of the maximum amplitudes of echoes reflected from an under dense meteor trail at different wavelengths, the initial radius of the ionized meteor trail can be calculated. N.E.A.

N63-16630 Harvard Coll. Observatory, Cambridge, Mass.
THE INITIAL DIAMETER OF METEOR TRAILS
Gerald S. Hawkins (Boston U.) *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 23–26 9 refs (See N63-16627 14-01) GPO: $2.75

An independent estimation of the initial diameter of meteor trails by direct photography is presented. Comparisons of the

optical data and radar measurements are analyzed. Disagreement between radar measurements and optical data suggests error in the former measurements. N.E.A.

N63-16631 Lund Observatory (Sweden)
THE RELATION BETWEEN VISUAL MAGNITUDES OF METEORS AND THE DURATIONS OF RADAR ECHOES
B. A. Lindblad *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 27–39 15 refs (See N63-16627 14-01) GPO: $2.75

The statistical relation between visual magnitudes of meteors and radar echo durations is investigated. A magnitude-duration linear relation is deduced from 688 Perseaid meteors observed at a radiofrequency of 9.2 meters. The scatter points in the magnitude-duration diagram is discussed. It is shown that this scatter, for constant visual magnitude, is related to the mean atmospheric height of the meteor. Also, meteors which lie high in the magnitude duration diagram are associated with persistent visual trains. Author

N63-16632 Commonwealth Scientific and Industrial Research Organization. Radiophysics Div., Chippendale, New South Wales (Australia)
RADIO-ECHO MEASUREMENTS OF METEOR MASS DISTRIBUTIONS
A. A. Weiss *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 41–43 5 refs (See N63-16627 14-01) GPO: $2.75

Mass distributions for sporadic and shower meteors are derived from radio-echo observations at 67 Mc/sec. The data used are total echo rates for the brightness range $6.0 < M_r < 7.5$, and durations of persistent echoes for $M_r < 2.5$. The mass distributions cannot be represented by simple inverse power laws with constant exponents s. For sporadic meteors, s increases from ~ 2.0 for the faint meteor group to 2.5 for the brighter meteors. For the η-Aquarid, δ-Aquarid, and Germinid showers, s also increases as the brightness increases. In common with the major northern hemisphere showers, the mass per unit magnitude range for these showers reaches a maximum well above the visual threshold. The δ-Aquarids are shown to exhibit a concentration of massive meteors towards the center of the stream. Author

N63-16633 National Research Council of Canada, Ottawa
A PRELIMINARY REPORT ON RADAR METEOR COUNTS
Peter M. Millman and Bruce A. Mc Intosh *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 45-51 3 refs (See N63-16627 14-01) GPO: $2.75

A meteor patrol radar equipment was put in operation at Springhill Meteor Observatory near Ottawa at the beginning of October 1957, and a continuous recording of meteor echoes has been carried out since this date. The antennas are omnidirectional, with operating frequency 32.7 mc/sec and peak power 20 kw. Echoes are recorded on 35-mm film in the form of a range-time record. Echo counts for each 10-minute interval, echo ranges and durations, and the intensity of background noise are punched manually on IBM cards from the film record. All film has been read for the 39 months of operation from October 1, 1957, to December 31, 1960, and over 4,400,000 meteor echoes have been recorded. Mean hourly echo rates range from a diurnal minimum of less than 100 to a diurnal maximum which in June at 8^h local time may be over 400. The maxima of the major meteor showers show up more distinctly in the rates for the long-duration echoes. There is a tendency for the shape of the monthly mean diurnal rate curve to repeat itself in the same months for successive years. Author

N63-16634 Harvard Coll. Observatory, Cambridge, Mass.
THE HARVARD RADIO METEOR PROJECT
Gerald S. Hawkins (Boston U.) *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 53–62 9 refs (See N63-16627 14-01) GPO: $2.75
(Contracts AF 19(122)-458-57 NBS-CST-7282, NBS-CST-7067; NSF Grant G-14699)

The Harvard Radio Meteor project is a multistation radar system in which a pulse train is reflected from the ion column of a meteor. Antenna, receivers and radio links, frequency controls, gate circuits, and display units of the system are described. The computer program for the system is presented. Results of reducing a total of 407 meteors to give radiants, velocities, and orbital parameters are given. N.E.A.

N63-16635 Kharkov Polytechnical Inst. (USSR)
METEOR RATES OBSERVED BY RADIO-ECHO TECHNIQUES DURING THE IGY-IGC PERIOD
K. V. Kostylyov (Kazan State U.) and B. L. Kashcheyev *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 63–65 4 refs (See N63-16627 14-01) GPO: $2.75

The diurnal meteor rates and seasonal variations are discussed for 1959. The minimum monthly means of diurnal meteor rates in 1959 occurred in February and March and were 2,834 and 2,695, respectively, while the maximum monthly mean 7,832, occurred in June. There was a threefold change of monthly means within a year. The difference between certain daily rates is still greater: 2,000 echoes for some dates in March and 10,000 echoes in June during the Arietid showers. Hourly meteor rates vary even more widely. N.E.A.

N63-16636 Kharkov Polytechnical Inst. (USSR)
THE ORBITS OF METEOR STREAMS DETERMINED BY RADIO-ECHO TECHNIQUES
B. L. Kashcheyev, V. N. Lebedinets, and M. F. Legutin *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 67–69 8 refs (See N63-16627 14-01) GPO: $2.75

Data are given and discussed on computed orbits of meteors of the Geminid, Arietid, and Delta-Aquarid showers as well as 360 sporadic meteors recorded in November and December 1959. A brief review of techniques and equipment used is presented. N.E.A.

N63-16642 National Research Council of Canada, Ottawa
A GENERAL SURVEY OF METEOR SPECTRA
Peter M. Millman *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 119–127 21 refs (See N63-16627 14-01) GPO: $2.75

Over 400 meteor spectra have now been photographed at various observatories, with most of the data having been obtained in three countries—Canada, the U.S.S.R., and the U.S.A. The range of wavelengths covered extends from 3000A to 9000A. The bright-line emissions for roughly 200 multiplets have now been identified with some certainty. These belong to 13 neutral atoms, 7 singly ionized atoms, and one molecule. The composition of

cometary meteoroids does not seem to differ markedly from that of stony meteorites. The excitation in a meteor spectrum depends chiefly upon the velocity of the meteor and its absolute magnitude. A simple system of meteor spectrum classification is suggested, based on an earlier proposal made by the author in 1935. Author

N63-16643 Czechoslovak Academy of Sciences. Astronomical Inst., Ondrejov

METEOR SPECTRA WITH HIGH DISPERSION

Zd. Ceplecha and J. Rajchl *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 129–153 10 refs (See N63-16627 14-01) GPO: $2.75

Analysis of photographs of two meteor spectra with dispersions from 72 A/mm to 11 A/mm is presented in this paper. The method of reduction is briefly described. Absolute wavelengths were computed without previous identification of any line, and the zero order of stars for determination of the coordinate system was used. The mean deviation of computed wavelengths from the wavelengths of identified lines is only ±0.2 A in the case of spectrum S 6. The lines of neutral iron predominate in both the meteor spectra. Author

N63-16644 Czechoslovak Academy of Sciences. Astronomical Inst., Ondrejov

A SHORT NOTE ON METEOR SPECTRA WITH LOW DISPERSION

J. Rajchl *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 155–156 6 refs Submitted for Publication (See N63-16627 14-01) GPO: $2.75

From direct photographs, the fundamental dynamical and physical characteristics for three spectra of meteors with low dispersion (about 200 A/mm in the blue region, and about 800 A/mm in the red region) was determined. The ratio of meteor-body diameter to the mean free path of the emitted molecules with respect to the oncoming molecules, and the flow conditions of the interaction between meteoric body and the surrounding atmosphere were determined. It is concluded that the ratio of meteor-body diameter to the mean free path of the emitted molecules with respect to the oncoming molecules is the more important factor governing the process of light emission and its efficiency. N.E.A.

N63-16645 Odessa Astronomical Observatory (USSR)

SPECTROGRAPHIC OBSERVATIONS OF METEORS IN U.S.S.R. IN 1957–1960

E. N. Kramer, K. A. Liubarsky (Astrophys. Lab., Ashkhabad), and V. I. Ivanidov (Astrophys. Inst., Doushanbe) *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 157–159 6 refs (See N63-16627 14-01) GPO: $2.75

Photographic observations of meteor spectra made in the U.S.S.R. during the international geophysical year are tabulated. Information is given on the stations participating, the equipment used, and the catalogs and dispersion of the spectra studied. D.E.R.

N63-16646 Dominion Observatory, Ottawa (Canada)

DIFFUSION EFFECTS OBSERVED IN THE WAKE SPECTRUM OF A GEMINID METEOR

Ian Halliday *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 161–169 10 refs (See N63-16627 14-01) GPO: $2.75

A study is made of an unusual Geminid meteor spectrum, photographed between heights of 73 and 47 km. Peak luminosity, estimated at magnitude −8, occurred near 59 km. The meteor exhibited a pronounced flicker, with a frequency varying from 50 to 300 cycles per second. The flicker may be associated with rotation or oscillation of the meteoroid. A prominent wake spectrum was photographed between 50 and 55 km, consisting of lines of Na I, Mg I, Ca I, Ca II, Mn I, and Fe I. The stronger lines are split into two distinct components attributed to a hollow luminous column rather than splitting of the meteoroid or Doppler effects. The diameter of the column varies from 40 to 80 meters, but shows no variation from one atom or ion to another. Diffusion coefficients computed from the observed rate of expansion exceed the normal values at these heights by a factor of more than 10^5. The expansion in this case might be considered as explosive.

Author

N63-16648 Sheffield U. (Gt. Brit.)

NEGATIVE IONS AND LUMINOSITY IN METEOR TRAINS

T. R. Kaiser *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 175–193 19 refs (See N63-16627 14-01) GPO: $2.75

The decay of meteoric ionization due to the combined effects of diffusion, electron attachment and detachment, and mutual neutralization of positive and negative ions, has been studied theoretically. It is proposed that the excited neutral atoms resulting from mutual neutralization produce meteor train luminosity. Interpretation of experimental data, in the light of the theory, leads to values for the electron attachment coefficient which agree reasonably with those obtained from radio observations and suggests that attachment occurs through a three-body process. Author

N63-16649 Czechoslavak Academy of Sciences. Astronomical Inst., Ondrejov

PRELIMINARY NOTES ON SOME RESULTS OF PHOTOGRAPHIC MULTIPLE METEORITE FALL OF PŘÍBRAM

Zd. Ceplecha *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 195–198 3 refs (See N63-16627 14-01) GPO: $2.75

The theory presented in this paper can be applied to meteorite falls. The heat-transfer coefficient at the end point of the light trajectory and thickness of the meteorite crust can be computed. The preliminary value of the heat-transfer coefficient at the end points of four Příbram meteorites was estimated to be about 0.002 or 0.003. The definitive numerical values will be published in the Bulletin of the Astronomical Institute of Czechoslovakia in a series of papers entitled "Multiple Fall of Příbram Meteorites Photographed." Author

N63-16650 Smithsonian Astrophysical Observatory, Cambridge, Mass.

LUMINOUS EFFICIENCY OF IRON AND STONE ASTEROIDAL METEORS

A. F. Cook, L. G. Jacchia, and R. C. Mc Crosky (Harvard Coll. Obs.) *In its* Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 209–220 8 refs (See N63-16627 14-01) GPO: $2.75

The theory of luminous efficiency and observation of this phenomenon are discussed for three meteors: one iron and two stone. The first is known to be pure iron from its spectrum. The other two yield results consistent with those of the first if they are assumed to be composed of meteoritic stone. A satisfactory comparison is made with the observed reentry of an artificial iron

meteor. The result is a determination of the luminous efficiency for iron and solid stone meteors, which is valid in the range of velocity from 9 to 21 km/sec^{-1}. D.E.R.

N63-16651 Yale U., New Haven, Conn.
METEOR IONIZATION AND THE MASS OF METEOROIDS
Donald M. Lazarus (Harvard Coll. Obs.) and Gerald S. Hawkins (Boston U.) *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 221–228 17 refs (See N63-16627 14-01) GPO: $2.75

An upper limit for the ionizing probability β is obtained for sodium atoms that have evaporated from the surface of a meteoroid entering the atmosphere, and the result is generalized to apply to the other meteor constituents. Comparison of this result with radio meteor measurements leads to a meteor mass which suggests an upward revision of the meteor mass scale. An upper limit for the luminous efficiency is also obtained. The lower limit for the mass of zero-magnitude Geminid meteor incident at 45° is found to be 6.86 gm, and the mass of a zero magnitude Perseid is 2.35 gm. Author

N63-16652 Academy of Sciences (USSR). O. Schmidt Inst. of Physics of the Earth, Moscow
STATISTICAL VERIFICATION OF THE PHYSICAL THEORY OF METEORS
B. J. Levin and S. V. Majeva *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 229–231 4 refs (See N63-16627 14-01) GPO: $2.75

By applying a least squares solution, the disperson parameters for both "normal" and "fragmenting" meteors are obtained. The least squares solution also gives values for the maximum absolute magnitude of a meteor flying into the atmosphere on a vertical plane. The initial mass of such a meteor is mathematically derived for a "normal" body. D.E.R.

N63-16653 Manchester U. Nuffield Radio Astronomy Labs., Macclesfield (Gt. Brit.)
ON THE COLOR INDEX OF METEORS
John Davis *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 233–236 6 refs (See N63-16627 14-01) GPO: $2.75

Objective measures of meteor color indices have been made with a two-channel photoelectric apparatus. Photo-cathode-filter combinations giving spectral responses corresponding to a Super-Schmidt photographic system and a mean visual observer have been used. The results show a variation of color index with meteor brightness in agreement with the subjective results of Jacchia and Davis. However, the variation can no longer be accounted for in terms of a physiological effect alone as proposed by Jacchia. It must arise from a real change in the meteor spectrum with meteor brightness as Ceplecha has suggested. This interpretation is further supported by the observations made with blue and red sensitive photoelectric channels. Author

N63-16654 General Electric Co., Schenectady, N.Y.
IMAGE-ORTHICON PHOTOGRAPHS OF METEORS
J. Spalding, C. L. Hemenway, J. A. Cole, J. F. Dugan (Dudley Obs.), and G. Colter *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 237–238 1 ref (See N63-16627 14-01) GPO: $2.75

Image-orthicon photography of meteors is discussed to make scientists aware of the characteristics of image-orthicon techniques in the study of meteors, and to seek advise for the best means of exploiting the capabilities of these techniques for meteor research. Image-orthicon techniques have very high sensitivities that permit good time resolution. Faint meteors, wakes, and trains can readily be studied by the technique. Also, magnitudes of meteors can be measured by direct comparison with the stars, since short-duration exposures are used. Low-resolution spectra of meteors and trains have been obtained by coupling an objective prism to the image-orthiconal equipment, and a transmission grating spectrograph has been constructed. D.E.R.

N63-16656 Canterbury U., Christchurch (N. Zealand)
THE ABSENCE OF MAGNETIC MICROPULSATIONS OF METEOR ORIGIN
C. Ellyett and G. B. Gillion *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 249–251 9 refs (See N63-16627 14-01) GPO: $2.75

Simultaneous observations of micropulsations greater than 0.3mγ at 1.5 c/s, and of meteors greater than magnitude +9.1, at the same site during the peak of occurrence of the δ-Aquarid meteor shower, failed to show any correlation, either with individual meteors, or on an hourly rate basis. Author

N63-16659 Smithsonian Astrophysical Observatory, Cambridge, Mass.
STATISTICS OF METEOR STREAMS
R. B. Southworth (Harvard Coll. Obs.) and G. S. Hawkins (Boston U.) *In its* Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 261–285 14 refs (See N63-16627 14-01) GPO: $2.75

A comprehensive quantitative criterion is established to classify the elements of meteoritic orbit around the earth. The differences, D, between meteors may be used as a means of determining membership in known streams and of finding new streams. The classification, though, is not discriminatory and a number of streams are found which may not exist. A method of estimating the number of spurious streams is given. Models of stream dispersion are given, tables of the newly found streams are included, and a mathematical method for computing the average gradients of the orbital elements with respect to perturbations is given. D.E.R.

N63-16660 Academy of Sciences of the Tajik SSR (USSR). Astrophysical Inst., Doushanbe
ORBITAL ELEMENTS OF PHOTOGRAPHIC METEORS
P. Babadjanov *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 287–291 3 refs (See N63-16627 14-01) GPO: $2.75

Orbital data for 132 meteors observed between June 1957 and December 1959 have been reduced. It may be concluded that: an increase in the orbservational material results in a decrease in the number of the so-called sporadic meteors and actual hyperbolic orbits constitute less than 1 percent of the whole orbital material on meteors. D.E.R.

N63-16661 Kiev U. Astronomical Observatory (USSR)
ON THE STRUCTURE OF THE δ-AQUARID METEOR SREAM
A. K. Terentjeva *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 293–295 8 refs (See N63-16627 14-01) GPO: $2.75

Some exclusive and peculiar properties of the delta-Aquarid meteor stream are discussed, including: the perihelion distance, the temperature at the perihelion, the radiants of the Aquarid shower, observations of the delta-Aquarid shower in the southern hemisphere, and geocentric velocity calculations. D.E.R.

N63-16662 Kazan State U. (USSR)
MASSES OF COMET GIACOBINI-ZINNER AND THE DRACONID METEOR STREAM
Y. V. Yevdokimov *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 297–298 2 refs (See N63-16627 14-01) GPO: $2.75

The conclusions that a considerable loss of mass occurs during each cometary revolution are proved by: (1) comparing the elements of the Giacobini-Zinner comet on successive revolutions around the solar system, (2) comparing the change in the longitude of the ascending node of both the comet Giacobini-Zinner and the meteor stream Draconid in 1940, resulting from the same force component perpendicular to the streams, and (3) multiplying the velocity of the ejected meteor particles by the ratio of their mass to the mass of the comet. It is calculated that during the period from 1939 to 1946, Comet Giacobini-Zinner ejected 17.5 percent of its mass. D.E.R.

N63-16664 Astrophysical Inst., Alma Ata (USSR)
A NOTE ON THE COMETARY NATURE OF THE TUNGUS METEORITES
V. Fessenkov *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 305–307 (See N63-16627 14-01) GPO: $2.75

The data supporting the conclusion that the Tungus meteorites are really a small comet belt surrounding the earth are presented and analyzed. These data are: the possession of retrograde motion common to comets by this meteorite body, the production of a strong aerial explosion wave that spread over the world, the widespread dispersion of the meteoritic matter by the explosion and the production of an increase in atmospheric extinction, the fact that no meteoritic fragments or evidence of impact was found, the scattering of solar light by the dust particles produced by the explosion, and the production of night brightness over most of the Northern Hemisphere. These facts are being interpreted to shed light not only on the Tungus comet (meteor) but also on other comets. D.E.R.

N63-16887 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A STUDY OF METEOROID IMPACT PHENOMENA Final Report
William J. Rae and Henry P. Kirchner Feb. 1963 183 p 70 refs (NASA Contract NAS3-2121)
(CAL-RM-1655-M-4) OTS: $13.10 ph, $5.69 mf

This report presents an analytical treatment of the process of crater formation in semi-infinite targets as a result of impact by hypervelocity projectiles. The results are achieved by using blast-wave theory to treat the fluid-mechanical phase of the target response, together with a simple means of accounting for the target strength in the later stages of the cratering process. The crater-size formula finally deduced is quite simple. The formula and its application are presented in a separate section. The simple crater-size formula reveals that the kinetic energy of the impacting particle is a controlling parameter, and that the dynamic strength of the target is the factor most effective in limiting penetration. Careful attention is paid to energy and momentum conservation, and the momentum of the incident particle is found to play a relatively minor role. Author

06 AUXILIARY SYSTEMS

Includes: fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters.

For primary propulsion systems see: 27 Propulsion

For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

N63-16355 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio
REACTOR INSTRUMENTATION AND CONTROL PROGRESS REPORT
Apr. 29, 1963 47 p
(Contract AT(40-1)-2847)
(GEMP-76) OTS: $1.25

Progress is reported on the following objectives: (1) the development of a method of nuclear reactor control with the capability of operating around sharp bends which may exist between the drive head and the control element; (2) the development of switching circuits utilizing solid-state devices in place of mechanical relays or electron tubes in order to achieve increased speed of operation, increased reliability, and reduced size and weight; (3) the development of a probe-type temperature sensor that will be more stable under the influences of high temperature and contaminating environments than present probe sensors; (4) the extension of conventional nuclear sensors for operation to higher temperatures, 1500° F for fission counters and 1000° F for d.c. ionization chambers; and (5) the development of advanced nuclear sensors for general use in the nuclear industry for monitoring and controlling high-temperature, high-performance reactors. I.v.L.

N63-16413 Southwest Research Inst., San Antonio, Tex.
CRASH-FIRE PREVENTION SYSTEM FOR A SUPERSONIC COMMERCIAL TRANSPORT Third Quarterly Technical Report
Calvin H. Yuill Feb. 15, 1963 22 p
(Contract AF 33(657)-8894)

The feasibility of adapting the crash-fire prevention system, as developed for subsonic aircraft, to the more stringent requirements of a supersonic commercial transport is discussed. I.v.L.

N63-16414 Hanford Atomic Products Operation, Richland, Wash.
IRRADIATION OF ZIRCALOY-2 CLAD URANIUM RODS IN NaK-FILLED CAPSULES, GEH 3-31, 32, 57, 58, AND 59 Final Report
J. W. Weber Apr. 29, 1963 50 p 11 refs
(Contract AT(45-1)-1350)
(HW-67072) OTS: $1.25

This report describes the design and fabrication of the capsules and fuel rods, the irradiation history, the results of the radiometallurgy measurements, and some metallographic observations made on the irradiated uranium and zirconium. N.E.A.

N63-16422 General Electric Co. Missile and Space Vehicle Dept., Philadelphia, Pa.
A FOOD REFRIGERATION AND HABITABLE ATMOSPHERE CONTROL SYSTEM FOR SPACE VEHICLES, DESIGN, FABRICATION, AND TEST PHASES [Final Report, Mar. 10, 1961-Apr. 10, 1962]
R. A. Miller and S. Halpert Wright-Patterson AFB, Ohio, Life Support Sys. Lab., Dec. 1962 201 p 72 refs
(Contract AF 33(616)-6902)
(AMRL-TDR-62-149) OTS: $3.50

The purpose of this development project was to design, fabricate, and evaluate a food-refrigeration and habitable-atmosphere control system which will support a three-man crew for an extreme altitude mission of 14 days and have additional capabilities for the storage, heating, and chilling of recovered water. The feasibility study and design study phases of the program indicated that a flight optimized system (i.e., a system with minimum power, weight, and volume characteristics) would be a system which utilizes a direct radiation to space concept to remove excess heat from the confines of a space vehicle. The equipment and systems were fabricated to assure their operability under the following extremes of environment: (1) Cabin pressure will vary between 0.5 to 1.0 atmosphere, (2) Equipment must operate in the presence of normal gravitational conditions as well as under a weightless condition, and (3) acceleration forces of up to 8G's must be withstood. Author

N63-16668 Naval Ordnance Lab., Corona, Calif.
PROPERTIES OF PHOTODETECTORS. PHOTODETECTORS SERIES, 51st REPORT [Jan.-May 1962]
W. L. Eisenman, J. D. Merriam, and A. B. Naugle June 1, 1962 31 p
(NASA WR-W-11085-B)
(NOLC-564; NASA-CR-50138) OTS: $3.60 ph, $1.13 mf

This report presents the results of measurements made on twelve photodetectors. It includes data sheets on lead selenide cells from the Eastman Kodak Company and the Santa Barbara Research Center; indium antimonide cells from the Philco Corporation; a Golay detector cell from the Eppley Laboratory, Inc.; and a thermocouple cell from the Perkin Elmer Corporation. It will be noted that tests conducted on the Golay detector and the thermocouple cells deviated from the normal procedure in that the blackbody response was measured at 50, 10 rather than the usual 500, 90. A summary of the data obtained is presented. Author

N63-16736 General Electric Co. Research Lab., Schenectady, N.Y.
SINGLE-CRYSTAL THERMIONIC CONVERTER STUDIES Scientific Report No. 3
H. F. Webster May 1963 15 p 10 refs
(Contract AF 19(604)-8424)
(AFCRL-63-452)

A thermionic converter is described in which the emitter is made of a single crystal of tungsten which has been cut to expose 16 square centimeters of 110 surface. Details of the cathode-surface preparation, anode construction, and assembly techniques are presented along with some operating characteristics from the first successful run. The output power was not as large as expected. A second run following reprocessing demonstrated improved performance, particularly at low cesium pressures. Author

N63-16742 Gulton Industries, Inc., Metuchen, N.J.
STATE OF CHARGE INDICATORS FOR NICKEL CADMIUM BATTERIES [Final Report, Jan. 1962-Jan. 1963]
M. Lurie, H. N. Seiger, R. C. Shair Wright-Patterson AFB, Ohio, Directorate of Aeromechanics, Feb. 1963 104 p 5 refs
(Contract AF 33(657)-8130)
(ASD-TDR-63-191)

The variations of several electrical properties of nickel cadmium cells with state of charge were studied to determine the suitability of any of these for measuring state of charge. Three methods were originally proposed: measurements of ohmic resistance, microsecond transients, and double-layer capacitance. During the investigations two additional parameters were measured, a.c. impedance and phase shift. Double layer capacitance and a.c. impedance and transient behavior are not useful properties for determining state of charge. A phase-shift system is described which, when properly calibrated, predicted state of charge with an average deviation of ±10%. Ohmic resistance measured under correct conditions showed a closer correlation to state of charge, but is difficult to measure. Author

N63-16776 Varian Associates, Palo Alto, Calif.
FOUR-CELL ROCKETBORNE MAGNETOMETER Final Report
Robert E. Morris Kirtland AFB, N. Mex., Research Directorate, Jan. 1963 43 p refs
(Contract AF 29(601)-5120)
(SWC-TDR-62-101)

The theory, design, installation, and successful operation of a four-gas-cell, wide-range, nearly omnidirectional rubidium-vapor magnetometer system intended for rocketborne use are described. Included is a detailed description of two coil systems and their power supplies and housing, comprising a magnetic test facility designed, fabricated, and installed at the Special Weapons Center. Each magnetometer will operate continuously in ambient magnetic fields ranging in intensity from approximately 100 gammas to more than 1 oersted (10^5 gammas). Since Rb^{85} is employed in the gas cells, the Larmor frequency can vary from nearly zero to approximately 500 kc/s in this field range; a signal processor developed for this magnetometer "maps" any signal within this band into an output signal varying in frequency between a few hundred cycles per second and 100 kc/s. Author

N63-16832 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
SINUSOIDAL STEADY-STATE ANALYSIS OF A LIMIT CYCLING CONTROL SYSTEM CONTAINING AN IDEAL CONTRACTOR
Ronald J. Nawrocky Apr. 17, 1963 45 p 10 refs
(Grant DA-ARO(D)-31-124-G201)
(PIBMRI-1101-62; AROD-2268-13)

The purpose of this work is to investigate the steady-state behavior of a nonlinear control system operating in a limit cycling mode when subjected to sinusoidal inputs. The system under consideration is the basic form of the Minneapolis-Honeywell control system with a linear compensation function and an ideal contactor in the forward loop. Author

N63-16863 Air Force Dept., Washington, D.C.
EVOLUTION OF THE VATE SYSTEM
Friedrich K. Guenthner *In* Air Force Missile Develop. Center Proc. of the AFMDC Inertial Guidance Test Symp., Vol. I, Holloman AFB, 16-17 Oct. 1962 p IX-1-IX-66 22 refs (See N63-16854 14-01)

The advantages of versatile automatic test equipment over "peculiar" test equipment in the Air Forces special repair activity are pointed out, followed by an evaluation and design criteria for automatic test equipment, a feasibility study of a standardized test approach, test control and control concepts, performance of a digital computer test and control of the test, the design of the VATE system, and an extension of the VATE concept. D.E.R.

N63-16922 Martin Co., Baltimore, Md.
RESEARCH PROGRAM ON MAGNETOHYDRODYNAMIC ELECTRIC POWER GENERATORS WITH AUXILIARY IONIZATION Quarterly Progress Letter No. 1, 15June-15 Sept. 1962
W. B. Bienert and C. Shih Sept. 24, 1962 6 p
(Contract Nonr-3866(00))
(MND-2866-1; AD-285849)

Research progress is reported for magnetohydrodynamic electric power generators with auxiliary ionization. Approximately 60% of the mechanical design of the experimental apparatus has been completed. Detailed drawings of the duct, the surrounding pressurized protection chamber, and the heating section have been

produced. In addition to the mechanical design of the MHD loop, the instrumentation layout has been made. For the theoretical and experimental ionization study, a discharge tube with an electrode arrangement similar to the actual geometry in the generator duct has been designed, built, and tested for helium and cesium ionization tests. An analysis of the operating characteristics of the MHD loop was performed for studying a closed cycle system that uses a reactor heat source. N.E.A.

N63-16934 Atomics International, Canoga Park, Calif.
SNAP SHIELD TEST EXPERIMENT FISSION-PLATE POWER CALIBRATION
R. L. Tomlinson, R. P. Johnson, S. G. Wogulis, R. E. Wengler, and J. D. Boren Aug. 15, 1962 36 p 17 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7432) OTS: $0.75

Three techniques were employed in measuring the fission rate of the STE fission-source plate: (1) the thermal neutron absorption rate, (2) power dissipation (calorimetric method), and (3) the fission-neutron production technique. The results obtained, when weighted according to the reciprocal of the squares of the estimated errors, yielded a fission rate of 1.97×10^{12} fissions/sec ±4% for a STE reactor power level of 50 kw. Assuming that 190 Mev of usable energy is liberated per fission of U^{235}, this fission rate corresponds to a fission-plate power of 59.9 watts ±4%. The calorimetric calibration technique proved to be the most satisfactory of the three techniques used. The average fission-plate power per unit area was determined to be 2.05×10^{-2} watts/cm^2 ±4%. Author

N63-16939 Atomics International, Canoga Park, Calif.
SNAP SHIELD TEST EXPERIMENT REACTOR PHYSICS TESTS
R. L. Tomlinson, R. P. Johnson, and S. G. Wogulis July 15, 1962 36 p 8 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7368) OTS: $0.75

The initial physics tests on the Shield Test Experiment reactor and the precriticality rod-drop test data are presented. Author

07 CHEMISTRY

Includes: chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis.

For related information see: 18 Materials, Metallic; 19 Materials, Non-metallic; and 26 Propellants and Combustion.

N63-16363 Esso Research and Engineering Co. Products Research Div., Linden, N. J.
ORGANIC COOLANT TECHNOLOGY First Semi-annual Progress Report, May through Oct. 1962
J. F. Black, M. E. Conn, and P. R. Geissler Washington, AEC Div. of Tech. Information, Dec. 14, 1962 66 p 7 refs
(Contract AT(10-1)-1124)
(IDO-11221) OTS: $1.50

A Pyrolytic Capsule Fouling Test apparatus has been constructed and successfully operated. Films formed from a sample of OMRE-Core II coolant have been analyzed for carbon-hydrogen content and for radioactivity. The percentage of carbon in the films is the same as that in the bulk coolant, while the hydrogen percentage in films is half that in the coolant. The films formed are more concentrated in inorganic ash and in Co^{60} and Mn^{54} than the used coolant by factors of about 10^3. A tritium labeled coolant was obtained by exposure of a sample of used coolant to tritium gas. Preliminary PCFT experiments with the H^3 labeled coolant indicates that the radiotracer method for determining the organic precursors of film formation is feasible. In tests designed to quickly screen adsorbents for their ability to remove S^{35} and P^{32} from organic coolants, reduced nickel oxide hydrogenation catalyst is outstanding and superior to the other 21 materials examined thus far. Author

N63-16387 Battelle Memorial Inst., Columbus, Ohio
OXIDATION RESISTANCE OF OXIDE-COATED UO_2 MICROSPHERES
George W. Cunningham, William H. Pfiefer, Donald C. Carmichael, and Edwin S. Hodge Apr. 2, 1963 32 p 6 refs
(Contract W-7405-eng-92)
(BMI-1625) OTS: $0.75

The mechanism and kinetics of oxidation of spherical UO_2 particles coated with Al_2O_3, BeO, and MgO, were studied by thermogravimetric techniques. Metallographic and X-ray diffraction data were obtained to support the conclusions. At temperatures below 1500° C, oxidation of Al_2O_3-coated particles occurred by diffusion of oxygen through the coatings, partial oxidation to U_3O_8, and subsequent cracking and complete oxidation. Oxidation resistance of Al_2O_3 particles coated at 1300° and 1400° C was superior to that of particles coated at 1000° C. Extrapolation of the measured data indicated that the particles coated at 1300° and 1400° C should have satisfactory oxidation resistance for several thousand hours at temperatures of 1100° C and lower. Beryllia-coated particles were also found to have good oxidation resistance at 1100° C, but BeO-coated particles are more sensitive to thermal stresses than Al_2O_3-coated particles. Magnesia-coated particles failed due to thermal stresses at 800° to 900° C. Author

N63-16431 New York U. Coll. of Engineering, N.Y.
DEVELOPMENT OF IMPROVED TITANIUM ORGANIC COMPOUNDS FOR USE AS HYDRAULIC FLUIDS Technical Report No. 2, 16 May-15 Aug. 1962
Max Kronstein Sept. 15, 1962 67 p
(Contract NOw-62-0647-d)

The fluid developed by this research group under the preceding project has been evaluated, and good high-temperature properties and excellent sheer stability have been established. The material was pourable at −70° F, but was solid when stored undisturbed at −40° F. The work is continuing with two main approaches: one, using a reaction of tetra alkyl titanate with basic zinc octoate, with titanium tetrachloride as catalyst; the other, reacting the two components in the presence of water, to more easily free the isopropyl groups of a tetra isopropyl titanate. The properties of these materials are under study. Both products have a flame point around 600° F. The reaction between tetra alkyl titanates with organics containing phosphoric groups is being studied in an effort to introduce phosphoric groups in the titanates. It is hoped that self-flame-extinguishing properties may be obtained beyond the present flame point. A reaction product between tetra isopropyl titanate and a tri octyl phosphate is studied as a viscosity reducing additive to the fluid complexes. Author

N63-16432 New York U. Coll. of Engineering, N.Y.
DEVELOPMENT OF IMPROVED TITANIUM ORGANIC COMPOUNDS FOR USE AS HYDRAULIC FLUIDS Technical Report No. 3, Aug. 16-Nov. 15, 1962
Max Kronstein Dec. 14, 1962 77 p
(Contract NOw 62-0647-d)

Special effort was directed to the question of the fire safety of the experimental fluid, and how far this can be influenced and

evaluated. The ASTM method of determining the flash and flame points, i.e., by heating a sample to a high enough temperature to cause the flash and flame effect, does not express the safety conditions of contact with open flames when the fluid itself is held below the high ranges of 550° F to 600° F such as are found for these materials. The synthesis work of this period has been directed at producing fluids with, as far as possible, complete removal of low boiling cuts, so as to decrease short flashes of low cuts below the flame point. Also, work has been directed at increasing the self-extinguishing properties after a short burning has taken place by the incorporation of phosphorus, halogen, or nitrogen, or combinations of these. Author

N63-16433 New York U. College of Engineering, N.Y.
DEVELOPMENT OF IMPROVED TITANIUM ORGANIC COMPOUNDS FOR USE AS HYDRAULIC FLUIDS Technical Report No. 4, Nov. 16, 1962-Feb. 28, 1963
Max Kronstein Mar. 15, 1963 79 p
(Contract NOw-62-0647-d)

Two special modifications of the fluid tetraisopropyltitanate–basic zincoctoate reaction product have been developed with the aim to produce increased stability under the test requirements for a hydraulic fluid while maintaining the fire safety conditions. These products are modifications of the product with tetra butyl tin and a modification of the product with tri-isopropyl borate. Special attention has been given to the relationship between the diluted mixtures of these products, using inhibited silicone-fluid 510 as diluent, and four-ball wear-test scar marks, and also to viscosity changes at low temperatures. Author

N63-16486 Isomet Corp., Palisades Park, N.J.
PREPARATION OF HIGH PURITY ANHYDROUS FERROUS CHLORIDE [Final Report, Mar. 14, 1961-Sept. 14, 1962]
Horace W. Chandler and Joseph Malgiolio Wright-Patterson AFB, Ohio, Directorate of Mater. and Processes, Mar. 1963 20 p 3 refs
(Contract AF 33(616)-8187)
(ASD-TDR-62-1040)

Several methods for preparing high-purity anhydrous ferrous chloride were investigated. The technique finally developed involved the high-temperature chlorination of iron sponge with anhydrous hydrogen chloride, and collection of the sublimed ferrous chloride in a condenser held at such a temperature that ferric chloride did not condense. Ferric iron was undetectable in the final product, and other impurities were well below the specified limits. Over 3 kilograms of high-purity anhydrous ferrous chloride were prepared by this technique. Author

N63-16495 Aberdeen Proving Ground. Coating and Chemical Lab., Md.
IDENTIFICATION AND DETERMINATION OF PLASTICIZERS IN LACQUERS BY PROGRAMMED TEMPERATURE GAS CHROMATOGRAPHY
George G. Esposito Apr. 16, 1963 16 p 2 refs
(CCL-141)

This report describes a procedure for the identification and determination of seven plasticizers in nitrocellulose, vinyl, and acrylic type lacquers by programed temperature gas-liquid chromatography (PTGLC). The chromatographic analysis is conducted on the sample which has been treated to remove the resins. Plasticizers are identified from their relative retention times and determined by the internal standard technique. Author

N63-16521 Feltman Research Labs., Picatinny Arsenal, Dover, N.J.
APPARATUS FOR GENERATING GASEOUS HYDROGEN AZIDE AND METHODS OF PREPARING SOME SELECTED AZIDES
Bruno Reitzner and Ralph P. Manno May 1963 13 p 2 refs
(PA-TM-1186)

An apparatus for preparing relatively large quantities of gaseous hydrogen azide has been designed. The hydrogen azide thus prepared can be used for reactions in the gas phase as well as in solutions. Methods for preparing sodium, potassium, ammonium, calcium, strontium, and barium azides have been developed. An attempt was made to prepare lead azide by reacting hydrogen azide with lead oxide. The formation of hydrazine sulfate was observed when hydrazoic acid was passed through concentrated sulfuric acid. Author

N63-16531 Royal Norwegian Air Force. Inst. of Aviation Medicine, Blindern
STUDIES ON THE STRUCTURE OF TETRAPYRROLS (BILIRUBIN)
J. Fog and E. Jellum Nov. 1962 3 p
(Rept. 62-4)

Conjugated bilirubins (esters) are formed within the liver cells from bilirubin and glucuronic or sulfuric acid. These compounds are unstable because of the highly reactive central methylene bridge. They are oxidized rapidly by the air and react immediately with diazotized sulfanilic acid. Contrary to the esters, pure bilirubin is relatively stable and reacts with the diazoreagent only when an accelerator is added. The nuclear magnetic resonance spectra, together with the infrared spectra, and the difference in reactibility of bilirubin and its conjugates, as well as the experience that the diesters are more reactive than the monoesters, seem to indicate that the stability of the bilirubin molecules is due to intramolecular hydrogen bonds. I.v.L.

N63-16538 California U., Berkeley. Lawrence Radiation Lab.
CHEMISTRY DIVISION ANNUAL REPORT, 1962
J. M. Hollander, F. L. Reynolds, J. C. Wallmann, eds., and I. Perlman Jan. 1963 351 p refs
(Contract W-7405-eng-48)
(UCRL-10624) OTS: $4.50

This report presents a review of research progress in the following areas: (1) radioactivity and nuclear structure, (2) fission, (3) nuclear reactions, (4) physical chemistry, (5) instrumentation, and (6) chemical engineering. N.E.A.

N63-16583 Bureau of Mines. Reno Metallurgy Research Center, Nev.
YTTRIUM BEHAVIOR IN RARE-EARTH-AMINE EXTRACTION SYSTEMS AND EFFECT OF SEQUESTRANTS
D. J. Bauer and A. C. Rice 1963 21 p 11 refs
(BM-RI-6242)

Solvent extraction techniques were used to determine the extraction sequence of yttrium and the rare-earth elements in an amine solvent extraction system. Single-stage extraction with Primene 81-R resulted in separation factors of 3.8 between yttrium and dysprosium, and 25 between yttrium and cerium. Yttrium was concentrated in the aqueous phase. EDTA and DTPA, as aqueous-phase counterextractants, enhance separation factors in amine-rare-earth sulfate systems. Yttrium separation from heavy rare-earth elements exhibits marked sensitivity to the position of yttrium in the selectivity scale of the rare-earth elements with the sequestrants. Yttrium-ytterbium separation is more effective with EDTA, whereas yttrium–dysprosium separation is more effectively increased with DTPA. Author

N63-16680 Avco-Everett Research Lab., Everett, Mass.
THERMAL ELECTRON IMPACT IONIZATION RATE CALCULATION FOR H, H_2, He, N_2, O_2, NO_2, A, AND Hg
G. Sargent Janes May 1963 12 p 7 refs
(Contract AF 49(638)-659)
(AMP-107)

This paper contains calculations which predict the rate at which ionization will occur in low density H_2, H, He, N_2, O_2, NO_2, A, and Hg gas due to the impact of thermal electrons. The results are presented as a function of electron temperature. There are two basic assumptions. The first assumption is that the electrons are assumed to have a Maxwell–Boltzman energy distribution. The second assumption is that all ionization takes place directly from the neutral ground state. The latter is the collision limited case and (with the exception of effects due to metastable states) is approximately satisfied for densities below 10^{14} particles per cm^3. Author

N63-16712 New York State U. Coll. of Forestry, Syracuse
ABSTRACTION OF HALOGEN ATOMS BY METHYL RADICALS [Final Report for Period Ending Oct. 30, 1962]
M. Szwarc, F. W. Evans, R. J. Fox, M. Feld, and A. P. Stenfani Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 38 p 41 refs
(Contract AF 33(616)-7662)
(ASD-TDR-63-273)

This report describes a study of halogen abstraction reactions described by the equation $R\,X + \cdot CH_3 \rightarrow R\cdot + CH_3$ in solution for R = CH_3, C_2H_5, iso- C_3H_7, t- C_4H_9, $PhCH_2$, CH_2Cl, $CHCl_2$ CCl_3 and CF_3. It was found that the Br abstraction from CCl_3Br proceeds about 1000 times faster than that from $PhCH_2Br$ in spite of the fact that the respective C-Br bond dissociation energies are nearly equal. Similarly, the I abstraction from CF_3I was found to be about 500 times faster than that from CH_3I, although $D(CH_3 - I)$ is again nearly equal to $D(CF_3 - I)$. These observations led to a notion that the repulsion between the approaching CH_3 radical and the stretched C - X bond is an important factor in determining the rate of abstraction. The ratios of k_2I/k_1 and k_2, Br/k_1 were found to be 45 and 6×10^{-3}, respectively, and these rate constants are compared with $k_2,H/k_1$; k_1 being the rate constant of the reaction $PhCH_3 + \cdot CH_3 \rightarrow PhCH_2\cdot + CH_4$. The addition of CF_3 radicals to propylene, isobutene, tetramethyl, ethylene, butadiene, cyclopentene, benzene, vinyl fluoride, vinyl chloride, and 2-fluoropropylene have been investigated in the gaseous and liquid phases at 65° C. Some problems of cage recombination are discussed.
Author

N63-16720 California U., La Jolla
THE UREY-CRAIG GROUPS OF CHONDRITES AND THEIR STATES OF OXIDATION
Hans E. Suess 1963 27 p 32 refs Dedicated to Harold C. Urey on his 70th birthday
(NASA Contract NsG-322-63)
(NASA-CR-50011) OTS: $2.60 ph, $1.01 mf

Some aspects of the problem of the origin of chondrules are discussed. It is suspected that the absence of a planet in the region of the asteroids, and the constant FeO content of the silicate minerals in the Urey–Craig groups, have a common cause in the marginal vapor pressure of water at the distance of the asteroids from the sun. In this area the formation of large solid bodies may have taken place in two steps. In the first step, water and other hydrides were solid. Together with metal and silicate grains, these solids accumulated into relatively large, perhaps lunar-sized planetesimals with relatively high center temperatures. The combined heats of accumulation and of radiation from the sun led to re-evaporation of the hydrides and to the redissolving of these objects. Thereafter, separation of gases from metal and silicate particles occurred. In the second step, metal and silicates accumulated into objects of the composition of meteorites. On the basis of such a complex picture, the existence of the various types of meteorites and their properties can be explained by several plausible *ad hoc* hypotheses. Author

N63-16733 Electric Boat Div. General Dynamics Corp., Groton, Conn.
THE INORGANIC SUPEROXIDES
D. L. Kraus (Rhode Island U.) and A. W. Petrocelli Repr. from J. of Chemical Educ., v. 40, no. 3, Mar. 1963 p 146–149 44 refs
(NASA Contract NASw-559)
(NASA-CR-50124)

The history, preparation, and structure of inorganic superoxides is reviewed. Since these compounds have important air revitalization properties, a chart is presented of the ratio of oxygen released per pound of superoxide for each superoxide compound discussed, together with an indication of its carbon dioxide absorption properties and availability. M.P.G.

N63-16738 Moleculon Research Corp., Cambridge, Mass.
RESEARCH ON BENZIMIDAZOLE DERIVATIVES Final Report [Mar. 1962–Feb. 1963]
A. S. Obermayer, L. D. Nichols, C. E. Breed, B. E. Norcross, and M. Panar Mar. 31, 1963 43 p 25 refs
(Contract AF 19(628)-418)
(AFCRL-63-444)

The synthesis, purification, and characterization of a large number of benzimidazole derivatives are described. Compounds have been prepared which allow for the correlation of systematic structural variations with the physical and electrical properties. Author

N63-16739 New York U. Coll. of Engineering, N.Y.
RESEARCH ON THE PREPARATION OF PURE METALS Final Report
Walter Brenner and Charles J. Marsel Mar. 15, 1963 82 p 70 refs
(Contract AF 19(604)-4124)
(AFCRL-63-97)

This report discusses research on the preparation of high-purity metals via the decomposition of certain unstable intermediates thereof. Experiments relating to the synthesis, purification, and analytical characterization of gallium, bismuth, barium, and yttrium are described. Basic research on the preparation and characterization of organic semiconductors is discussed with emphasis on the effect of chemical purity on the electronic properties of a series of polycyclic aromatic hydrocarbons. The preparation and electronic properties of certain acetylenic polymers are discussed. Author

N63-16931 Aerojet-General Corp., Azusa, Calif.
KINETICS OF THREE-BODY ATOM RECOMBINATION
C. B. Kretschmer and H. L. Petersen June 1962 31 p 20 refs
(Contract AF 49(638)-540)
(Aerojet Rept. AN-625; AD-283042)

The following values of the three-body recombination rate constant in units of $cc^2/mole^2sec$ were measured at 300° or 350° K:

$$N + N + N_2 \rightarrow N_2 + N_2,\ 8.0 \times 10^{14};$$
$$N + O + N_2 \rightarrow NO + N_2,\ 3.3 \times 10^{15};$$
$$H + H + H_2 \rightarrow H_2 + H_2,\ 8.9 \times 10^{15}.$$

The rate constant for the reaction $N + O \rightarrow NO + O$ was found to be 5×10^7 cc/mole sec at 350° K. A statistical-mechanical calculation of the three-body recombination rate constant gave values which agreed well with the above experimental results and also reproduced the previously determined value of $< 2.5 \times 10^{16}$ $cc^2/mole^2sec$ for $O + O + O_2 \rightarrow O_2 + O_2$. The large variation in rate constant for different gases is due mainly to differences in atomic masses and statistical weights. Redissociation of molecules in high vibrational levels is important in reducing the net rate of recombination. At high temperatures, the theory predicts a rate constant varying as $T^{-0.4}$. Author

N63-16953 Wyandotte Chemical Corp., Mich.
SYNTHESIS OF LOW TEMPERATURE OIL RESISTANT URETHANE ELASTOMERS Quarterly Progress Report No. 3, 1 Jan. 1963-31 Mar. 1963
S. L. Axelrood et al Apr. 1, 1963 22 p
(Contract DA 20-018-ORD-24883)

Urethane and urethane-urea elastomers were prepared and their properties evaluated. The low-temperature flexibility specification was met for the first time by an elastomer which was prepared and tested. This elastomer was prepared by using diol–triol blends, which serve as mutual plasticizers reducing the crystallinity of the individual polyols at low temperatures. The diol components had a major effect on lowering torsional modulus at −55° C. The type of diisocyanate was varied on a 4500-molecular-weight polyether triol (Pluracol TPE 4542)-o-dichlorobenzidene (DCB), 1/1 NH_2/OH ratio elastomers. Quasi-prepolymers were prepared for this diisocyanate study in order to obtain liquid diisocyanate components. Properties varied considerably with variation of the diisocyanate. Urethane elastomers containing no urea linkages were evaluated and compared to similar elastomers containing urea linkages in an attempt to evaluate more closely the effect of the various components, urethane, urea, and polyether backbone on properties of the resultant elastomers. Author

N63-16976 New York U. Coll. of Engineering, N.Y.
LITERATURE SURVEY ON THE PREPARATION OF METALS FROM ORGANOMETALLIC COMPOUNDS Scientific Report No. 1
Minoru Tsutsui and Donald Lorenz Mar. 1963 21 p 58 refs
(Contract AF 19(628)-1685)
(AFCRL-63-22)

This literature survey covers the reported work on the preparation of metals from organometallic derivatives. The main emphasis has been placed on the transition and rare earth metal-organic compounds with thermal or chemical methods of recovery. Author

N63-16977 Royal Inst. of Tech., Stockholm (Sweden)
RESEARCH ON CHARACTERISTICS OF TRANSITION ELEMENTS IN SOLUTION. I. STUDIES ON RHODIUM CHEMISTRY WITH A NOTE ON PALLADIUM. 2. STUDIES ON RUTHENIUM CHEMISTRY Technical (Final) Report
Clara Berecki-Biedermann, Felipe Brito, and Derek C. Lewis Feb. 1963 96 p 56 refs
(Contract AF 61(052)-417)
(AFCRL-63-456)

Systematic studies were made on the preparation and characterization of halogenide-free rhodium sulfate and perchlorate solutions. Improved methods of preparation and analysis were worked out. Hydrolysis and half-cell studies are presented. Absorption spectra are given for the solutions prepared. Pure palladium (II) perchlorate and sulfate solutions were prepared by first precipitating with $HClO_4$—hydrous palladium oxide from a clear alkaline solution of $Pd(NO_3)_2$—and then dissolving the precipitate in cold $HClO_4$ (H_2SO_4). Earlier described preparative and analytical methods for ruthenium have been improved and new ones introduced. Catalyst reduction with H_2 gas on a Pt catalyst proved a useful tool. Redox reactions of Ru in 1 M H_2SO_4 medium were studied. A mathematical analysis of some of the redox curves has been attempted. Absorption spectra are given, and possible lines for future work on ruthenium chemistry are indicated. N.E.A.

08 COMMUNICATIONS

Includes: communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation.

For tracking stations see: 10 Facilities.

For related information see: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation; and 22 Navigation and Guidance.

N63-16367 Hazeltine Technical Development Center, Inc., Indianapolis, Ind.
SMALL, LIGHT-WEIGHT ALTITUDE TRANSMISSION EQUIPMENT Final Report
Apr. 1963 119 p
(Contract ARDS-477)

The design and development of the Small, Light-Weight, Altitude Transmission Equipment (SLATE) for the Federal Aviation Agency Aviation Research and Development Service, are described. Both SLATE I and SLATE II operate at a transmitter frequency of 1090 mc and receiver frequency of 1030 mc. SLATE I reply codes include any of 33 altitude codes plus an IDENT pulse. SLATE II reply codes include any one of 33 altitude codes in Mode C or codes 00 through 77 (64 codes), plus the IDENT pulse in Mode 3A. Both SLATE modes incorporate additional circuits to provide echo suppression and side-lobe suppression. A pressure cell-controlled servosystem was adopted as an altitude transducer. An adequate transmitter oscillator was developed using a miniature triode. All specified performance characteristics were met or exceeded. Author

N63-16371 Centro Radioelettrico Sperimentale G. Marconi, Rome (Italy)
RADIOCOMMUNICATION BY BACKSCATTER Final Technical Report
(Contract AF 61(052)-139)
(AFCRL-63-101)

The results are given of experimental research concerning the dependence of the backscatter intensity on the ground nature, and the influence of the vertical radiation diagram of the antenna on the deformation of the backscattered signals. Author

N63-16381 Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE SMITHSONIAN'S SATELLITE-TRACKING PROGRAM: ITS HISTORY AND ORGANIZATION
E. Nelson Hayes Washington, Smithsonian Inst. 1962 53 p refs
Repr. from the Smithsonian Report for 1961 p 275–322
(*Its* Publ. 4482)

The Smithsonian Institute's facility for the observation and tracking of artificial satellites is outlined with the emphasis being placed on the instrumentation used. The main systems presented are: the Baker optics, the Nunn camera, the Norrman clock, camera stations, the moonwatch experiments, Harvard meteor program, and the computing and communications systems employed. D.E.R.

N63-16437 Watkins-Johnson Co., Palo Alto, Calif.
DEVELOPMENT OF AN E-BAND AMPLIFIER [Tech. Note No. 7, July 1–Sept. 30, 1962]
E. W. Kinaman [1962] 16 p 1 ref
(Contract AF 30(602)-2422)
(W-J 62-410R28; RADC-TDR-62-586; AD-292794)

Improvement of subassembly losses during this interval has eliminated the apparent cause of the low gain reported for tube

No. B3. Improved alignment and coupling of larger diameter YIG spheres have netted filter resonant losses of only 1.3 to 2.0 db across most of the band at 200 mc instantaneous bandwidths. Author

N63-16448 Army Missile Command. Electromagnetic Lab., Redstone Arsenal, Ala.
PRELIMINARY EVALUATION OF THE MINI-BALL TARGET SYSTEM
Dorwin L. Kilbourn Mar. 11, 1963 24 p
(RE-TR-62-6)

This report covers work that has been done to date on the use of metal spheres as targets for guided-missile radar systems. These spheres are fired from a tripod-mounted shotgun. Results are given of the tests made on the properties and use of this device, which has been named the mini-ball target system. Author

N63-16485 Space-General Corp., El Monte, Calif.
EXPERIMENTAL RESEARCH INVESTIGATION OF EXTREMELY LOW FREQUENCY PROPAGATION Scientific Report No. 1
R. D. Smith, P. F. Kuhnle, and T. M. Georges Feb. 15, 1963 54 p 5 refs
(Contract AF 19(628)-1603)
(AFCRL-63-46; SGC-212R-4)

Characteristics of ELF electromagnetic wave propagation were investigated by measuring the characteristics of cw signals transmitted over a 400-cps link established between Boron, California, and Carlsbad, New Mexico, a distance of 1300 km. Propagation measurements were carried out during July and October 1962. Signal strength, received and transmitted signal phase, and atmospheric noise were recorded. Data reduction and analysis showed that received values of signal strength were 2 db less during nighttime and 4 db less during daytime than the values predicted by analytical studies carried out previously. Data reduction and analysis of the recorded phase data showed that more stable reference signal sources are required at transmitter and receiver. The form of the record obtained over a link which had approximately a 6-db signal-to-noise ratio in a 1-cps band indicates that a useful technique has been evolved. Atmospheric-noise data were recorded for all transmission periods. These data are presented in the form of amplitude probability distributions and impulses per unit time distributions. Author

N63-16514 Johns Hopkins U. Carlyle Barton Lab., Baltimore, Md.
THE DETECTION OF MULTIPLE UNKNOWN SIGNALS BY ADAPTIVE FILTERS Technical Report
J. W. Smith May 1963 133 p 13 refs
(Contract AF 33(657)-11029)
(AF-103)

Filters which modify their structures in order to recognize initially unknown waveforms in Gaussian noise are investigated experimentally. The class of filters discussed includes two types previously described in the literature, and one new type designed explicitly for operating in a multiple waveform environment. The new structure processes the data in a nonlinear fashion and effectively sets up a narrow decision region about the estimate of the waveform. The parallel operation of adaptive systems for detecting and estimating the signal parameters of multiple signals simultaneously is also discussed. The emphasis is on the effects of time-of-arrival errors and incorrect-decision errors such as false alarms and incorrect signal identification. Low signal-to-noise ratios, 5 to 20 (7 db to 13 db), are studied. The results clearly demonstrate the possibility of using filters of the new type for automatic data processing. Results are given in the form of learning curves which show the effects of correct and incorrect decisions. Included in much of the discussion is a graphical interpretation of the filtering process. Two unusual applications of the new filter structure are discussed in the appendices. Author

N63-16516 Lockheed Missiles and Space Co., Sunnyvale, Calif.
R-F BLACKOUT PHENOMENA: AN ANNOTATED BIBLIOGRAPHY (1959-1962)
George R. Evans, comp. Apr. 1962 86 p 150 refs
(Contract AF 04(647)-787)
(SB-62-18; AD-278678)

When a space vehicle or missile reenters the earth's atmosphere, the ionization of the air around the reentry body in the presence of applied magnetic fields creates an R-F blackout. This situation prevents communication between the space vehicle and ground stations, and increases the difficulty of radar identification of a reentry body. The references cited contain information on the theoretical and experimental studies of the causes of the R-F blackout phenomenon and possible solutions to the problem. The period covered is 1959 to February 1962. Author

N63-16530 Aro, Inc., Arnold Air Force Station, Tenn.
RADIATION TRANSMISSION THROUGH SHIELDING ARRAYS FOR LOW TEMPERATURE PUMPING SURFACES
W. G. Kirby Arnold Engineering Development Center, May 1963 32 p 6 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-75)

The results of an investigation to determine the amount of thermal radiation transmitted through two cryosurface configurations are presented. The configurations were composed of a 20° K cryosurface enclosed in a 77° K box, with a test opening shielded by an optically dense array of 77° K cryosurfaces coated with Parson's black. Radiation at various levels of intensity was applied to the shielding-array opening, and the heat load on the 20° K cryosurface imposed by energy transmitted through an array was measured. Heat transmission was also investigated with frost layers deposited over the Parson's-black coating on the shielding surfaces. Author

N63-16554 Syracuse U. Research Inst., N.Y.
TRANSIT TIME EFFECTS IN PHASED ARRAYS
Richard Gildersleeve Griffiss AFB, N.Y., Techniques Lab., May 1963 121 p 3 refs
(Contract AF 30(602)-2646)
(RADC-TDR-63-67; SURI-EE957-6302T4)

This report presents a set of pulses produced at given points in space as a result of exciting an array of 49 elements, with half-wave spacing, by pulses of five cycles and less; the phase of the excitation was varied to cause the main lobe to scan through 20 degrees off boresight. The techniques for applying the results to excitations of more than five cycles were given. A family of radiation patterns are given, to show the variations in the patterns as a function of time, for the several pulse durations studied. The curves clearly show the buildup and decay of the patterns, the fluctuations in the side-lobe structure, and the growth and decay of the main lobe, both in width and amplitude. It was concluded that this method of excitation and lobe switching is feasible provided the minimum pulse duration is determined for the given array size and desired scan angle, based upon specified limits in main-lobe degradation. Side-lobe suppression could be provided by appropriate selection of amplitude distribution. Author

N63-16789 Johns Hopkins U. Carlyle Barton Lab., Baltimore, Md.

REPRESENTATION AND DETECTION OF MULTIPLE-EPOCH SIGNALS

Tzay Y. Young May 1963 60 p 14 refs
(Contract AF 30(602)-2597)
(RADC-TDR-63-142)

The purpose of this report is to design a procedure for the detection of the individual epochs of overlapping signals and to represent them properly. The multiple-epoch signal may be corrupted with random Gaussian noise of zero mean. The individual signals are assumed to be representable by a set of exponential functions with acceptable error, and the exponents of this set of exponentials are assumed known. Any two adjacent epochs are assumed to be separated at least T_0 seconds apart. For the signal uncorrupted with noise, a criterion based on the error energy is described which is of theoretical interest. This criterion is useful for the detection of first epoch only. To detect the second epoch, the first signal is subtracted from the original signal by means of the "complementary" operator concept. For a noisy signal, a likelihood ratio criterion is proposed. Preliminary experimental results carried out on a digital computer justify the theoretical study. Author

N63-16843 Army Missile Command. Guidance and Control Lab., Redstone Arsenal, Ala.

IMPROVED UTILIZATION OF TELEMETRY CAPACITY

Ben D. Cobb and William F. Baxter June 29, 1962 44 p
(RG-TR-62-3)

The objective of this study is to devise and determine the feasibility of several schemes and systems to transmit more information, as opposed to more data, over a limited amount of telemetry capacity. An attempt is made to develop a figure of merit for missile instrumentation systems. Data bandwidth reduction and transmitter bandwidth utilization are considered as separate problems. The concept of classes of measured parameters and class reduction as a data bandwidth-reduction technique is explored. The potential of adaptive techniques is discussed. Several recommendations for the immediate improvement of utilization are outlined. Author

N63-16900 National Bureau of Standards. Central Radio Propagation Lab., Boulder, Colo.

CURVES OF GROUND PROXIMITY LOSS FOR DIPOLE ANTENNAS

L. E. Vogler and J. L. Noble May 20, 1963 41 p 6 refs
(Partially sponsored by JPL)
(NBS-TN-175) OTS: $0.30

Ground proximity loss, defined as the decibel ratio of antenna input resistance to its free space resistance, is presented in graphical form for four types of antennas: vertical, horizontal, electric, and magnetic elementary dipoles. Assuming a nonlayered ground characterized throughout by a relative dielectric constant ϵ and conductivity σ, curves are given showing the ground proximity loss for a wide range of values of ground constants, antenna height above the ground surface, and frequency. Author

N63-16915 Illinois U. Engineering Experiment Station, Urbana

THEORETICAL BRILLOUIN (K-β) DIAGRAM FOR MONOPOLE AND DIPOLE ARRAYS AND THEIR APPLICATION TO LOG-PERIODIC ANTENNAS

K. E. Jones (Hughes Aircraft Co.) and R. Mittra Apr. 1963 25 p 65 refs
(Contract AF 33(657)-10474)

The characteristic equation is derived for the complex propagation constant in a transmission line periodically loaded with dipole elements. This equation is solved for real and imaginary parts of the mode-propagation constants. The effect of mutual impedance between antenna elements is included in the formulation and calculation. Theoretical calculations are compared with experimental results reported by Mayes and Ingerson. The usefulness and limitation of the Brillouin (k-β) diagram for analyzing LP structures are discussed briefly. Author

N63-16919 Johns Hopkins U. Carlyle Barton Lab., Baltimore, Md.

DISCRETE, FINITE REPRESENTATION OF A LINEAR, STATIONARY SYSTEM

P. J. Butterly May 1963 50 p 6 refs
(Contract AF 30(602)-2597)
(RADC-TDR-63-124)

This report describes a linear system representation suitable for use with signals of finite dimensionality. This representation takes the form of a matrix with elements which depend both on the choice of signal basis and on the transmission properties of the system. The first part of the report is devoted to the derivation of the system matrix for an arbitrary-system transfer function for several widely-used signal bases; the second part considers the case in which only the system matrix is known. An equivalent representation, expressed in terms of a continuous parameter, is introduced to facilitate approximation of the system transfer function, and transformation formulas are established for a number of cases where they have a simple form. Author

N63-16949 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MOTS—THE MINITRACK OPTICAL TRACKING SYSTEM

D. W. Harris, J. H. Berbert, E. J. Habib, and B. W. Mc Kendree Repr. from Phot. Sci. Eng., v. 7, no. 2, Mar.–Apr. 1963 p 73–78 2 refs

The Minitrack Optical Tracking System (MOTS) is an outgrowth of the Minitrack calibration technique. It employs the same camera used in the calibration. When tracking the brighter satellites, a modification is connected by which the plate is moved laterally in a time-coded sequence temporarily displacing the trail. This replaces the need of using a shutter to "chop" the trail. Positional accuracies of less than 5 sec of arc are realized for satellites brighter than sixth magnitude. Author

N63-16950 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MINITRACK CALIBRATION SYSTEM

J. H. Berbert, J. D. Oosterhout, P. D. Engels, and E. J. Habib [May 1962] Repr. from Phot. Sci. Eng., v. 7, no. 2, Mar.–Apr. 1963 p 78–83 4 refs

The calibration cameras and associated equipment employed in the airplane calibrations of the Minitrack satellite tracking stations are described. The methods for dealing with the various optical and electrical system errors, and the results obtained with this system over the past five years are also given. Author

N63-16962 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.

LONG LINE EFFECT IN CONNECTION WITH CAVITY RESONANCES

H. M. Altschuler Apr. 17, 1963 18 p 2 refs
(Grant AF-AFOSR-62-295)
(PIBMRI-1148-63)

When resonant cavities are separated from relatively small obstacles by long waveguides, either multiple resonances or resonant frequency shifts may occur. This long-line effect is explored for both transmission and reflection cavities, and is found to be much more serious in the former than in the latter case. It can usually be eliminated by matching procedures. Author

09 ELECTRONICS

Includes: circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory.

For related information see: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N63-16389 Air Force Cambridge Research Labs. Electronics Research Directorate, Bedford, Mass.
CANCELLATION OF DOPPLER FREQUENCY SHIFT
Richard M. Waetjen Mar. 1963 26 p 5 refs
(AFCRL-63-70)

A circuit is described which is capable of canceling first-order Doppler frequency shifts. It has potentialities in the fields of communication, data transmission, and navigation systems for vehicles moving at high velocities. The circuit has the following features: (1) Received and transmitted frequencies at each of the stations involved are different, thus preventing feedback from the transmitting to the receiving antenna at the stations. (2) Amplification of the signals is provided at a frequency which can be chosen to have a convenient value. This factor is important in the case of microwave systems, since high-gain microwave amplifiers are much more expensive than, and not as reliable as, IF amplifiers operating at frequencies in the 1- to 300-megacycle range. (3) The system is capable of continuous-wave operation and simultaneous transmission and reception at each of the communicating stations. Author

N63-16392 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPECTRALLY SELECTIVE PHOTODETECTORS FOR THE MIDDLE AND VACUUM ULTRAVIOLET
Lawrence Dunkelman, Walter B. Fowler, and John P. Hennes Washington, NASA, May 1963 13 p 32 refs Presented at the meeting of the Opt. Soc. of Am., Los Angeles, Oct. 1961 Submitted for Publication
(NASA TN D-1759) OTS: $0.50

Numerous "solar blind" photodetectors have been developed in recent years. Measurements made on several phototubes with photocathodes of rubidium–tellurium, cesium–tellurium, cesium–iodine and copper–iodine are described. Cathode quantum efficiencies for semitransparent cathodes of rubidium–tellurium or cesium–tellurium range from 10^{-1} to 10^{-2} photoelectrons/quantum in the middle and vacuum ultraviolet, with long wavelength responses of less than 10^{-4} photoelectrons/quantum beyond about 3500A. By combining solar-blind cathodes with windows of LiF, CaF_2, or fused silica, detectors with relatively flat quantum efficiencies can be produced, marked by high sensitivities in specific ultraviolet spectral regions and by very low sensitivities at all longer wavelengths. Author

N63-16463 New York U. Coll. of Engineering, N.Y.
REALIZABILITY CONDITIONS ON TWO-PORT NETWORK PARAMETERS Second Scientific Report
Robert Maisel Mar. 1963 28 p 3 refs
(Contract AF 19(628)-379)
(AFCRL-63-85)

In this paper, the necessary and sufficient conditions for the realizability of linear, passive, time invariant two-port networks are derived in terms of the various two-port parameters. The two-port parameters considered are: the open-circuit impedance (Z) parameters, the short-circuit admittance (Y) parameters, the hybrid (H) parameters, the transmission (ABCD) parameters, and the scattering (S) parameters. The derivation is based on the definition of a positive real impedance matrix for a two-port network. Author

N63-16493 Robertshaw-Fulton Controls Co. Aeronautical and Instrument Div., Anaheim, Calif.
MULTILOK HIGH SPEED DATA MODEM– MODEL 6005 Final Engineering Report
Mar. 1, 1963 47 p 4 refs
(Contract ARDS-555)
(Rept. 909-026-019)

The Robertshaw Multilock high-speed data modem was adapted for operation with a ground-air-ground digital communications link. The modems employ phase-shift modulation techniques with synchronized data rates up to 1200 bits per second. Solid-state components are used throughout the equipment. Error rates of less than 1 in 10^5 bits were recorded for line signal-to-noise ratios of 15 db or greater. Error-free data transmission was achieved in the absence of noise over a dynamic range of 50 db on the demodulation input. Author

N63-16510 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
THE INTERCHANGE OF SOURCE AND DETECTOR IN MICROWAVE MEASUREMENTS Research Report
H. M. Altschuler Apr. 11, 1963 22 p 6 refs
(Grant AF-AFOSR-62-295)
(PIBMRI-1149-63)

The technique for interchanging generator and detector in the impedance measurement of microwave one-ports is a useful, known procedure often applied when low powers are indicated. The necessary and sufficient conditions for the validity of such measurements are critically examined, and direct extensions of this technique to similar measurements of reciprocal two-ports are given. A completely separate analysis is necessary when such an interchange is made in the case of an interference bridge to be used for the determination of the scattering parameters of general (active or passive and reciprocal or nonreciprocal) two-ports. This analysis is presented in detail. It results in a new low-power-level version of a method of measuring general two-ports given in an earlier paper. The measurement technique and the subsequent data analysis of the two versions are found to be identical, except that the two scattering parameters S_{12} and S_{21} appear in interchanged positions. Author

N63-16515 Johns Hopkins U. Carlyle Barton Lab., Baltimore, Md.
A FORMING STUDY OF POINT-CONTACT TUNNEL DIODES Technical Report
H. J. Lory May 1963 100 p 61 refs
(Contract AF 33(657)-11029)
(AF-104)

The factors involved in the forming of point-contact tunnel diodes by the application of brief electrical overloads are studied. As a test of the theory, a diode fabricated from N-doped germanium and an aluminum catwhisker is used. After a brief review of the thermal and electrical conductivities of heavily doped germanium at elevated temperatures, an evaluation is made of the critical breakdown voltage (the applied voltage below which no forming of any type occurs), assuming constant electrical and temperature-dependent thermal conductivity. Junction effects are taken into account by considering the "cold" diode characteristic in predicting a voltage below which current is limited by junction effects and above which spreading resistance dominates. This yields a value of series voltage which must be subtracted from the applied pulse voltage in calculating an effective critical voltage. The critical voltage for the sample diode is calculated and the result agrees well with experiment. Author

N63-16522 Los Alamos Scientific Lab., N. Mex.
NET-1 NETWORK ANALYSIS PROGRAM
Allen F. Malmberg and Fred L. Cornwell Apr. 30, 1963 150 p 3 refs
(Contract W-7405-eng-36)
(LA-2853) OTS: $2.75

NET-1 is a program for the MANNIAC II computer which simulates and describes through printed summaries and graphs the d.c. steady-state behavior and the transient behavior of a large class of electrical circuits which may contain passive and solid-state components. This report describes how the program is used. Part one of the report discusses the preparation of input for the NET program, the interpretation of results, and operating details. Part two discusses the models, or equivalent circuits, of transistors and diodes in the NET program, and the parameters which control the behavior of the models. Part three discusses auxiliary computer programs which are available to facilitate preparation of input and processing of output in the NET program. N.E.A.

N63-16526 Lockheed Missiles and Space Co., Sunnyvale, Calif.
RADIATION EFFECTS ON SPACECRAFT ELECTRONICS SYSTEMS, COMPONENTS AND MATERIALS: AN ANNOTATED BIBLIOGRAPHY [JANUARY 1960–JULY 1962]
Helen B. Mc Cormick, comp. Dec. 1962 175 p 415 refs
(SB-62-46)

N63-16572 Minnesota U. Plasma Physics Research Lab., Minneapolis
PROPERTIES OF VACUUM AND GAS DIODES Scientific Report No. 1 [Feb. 1961-Feb. 1963]
Hendrik J. Oskam and C. Bruce Johnson Mar. 1963 96 p 49 refs
(Contract AF 19(604)-8072)

This technical report is concerned with the properties of vacuum and gas diodes. The equations describing the properties of these two types of diodes are compared for the situation in which the diode current is space-charge limited. The screen anode of an auxiliary discharge is used as the cathode of the gas diode, and the properties of this type of cathode were studied. The experimental results are reported. Author

N63-16737 Curtiss-Wright Corp. Electronics Div., East Patterson, N.J.
STUDY OF PROJECTION IATRON APPLICATION TO HIGH SPEED MULTICHANNEL PLOTTER Final Report
Max Kerman Mar. 16, 1963 20 p
(Contract N61339-1188)
(NAVTRADEVCEN-1188-1)

This was a study to explore the feasibility of using the projection Iatron (FW-201) as the display readout device in a high-speed multichannel electronic plotting display system. The primary task is the evaluation of its suitability as determined by its storage, resolution, brightness, and writing rate. Existing equipment was therefore temporarily modified to provide the proper operating signals and voltages in accordance with the proposed application and the Iatron specifications. The equipment was checked out using an experimental tube. The two regular projection Iatrons (FW-201) were then tested. The tubes provided high-brightness line traces (though somewhat lower than normal) but the resolution obtained at 6,000 and 9,500 foot-lamberts was 0.0625 inches at the screen. This is equivalent to 72 television resolution elements in a 4.5-inch display diameter. This resolution would be degraded still further at the rated saturation brightness value to about 60 television lines. Author

N63-16749 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionali, Frascati (Italy)
A PRELIMINARY INQUIRY ON THE COURSE OF THE DISCRIMINATING CURVE OF A TUNNEL DIODE DISCRIMINATOR AS A VALUE FUNCTION OF THE PARASITIC ELEMENTS OF THE SAME DIODE (INDAGINE PRELIMINARE SULL' ANDAMENTO DELLA CURVA DI DISCRIMINAZIONE DEL DISCRIMINATORE A DIODO TUNNEL IN FUNCZIONE DEL VALORE DEGLI ELEMENTI PARASSITI DEL DIODO STESSO)
M. A. Locci, F. Panderese, and M. Puglisi Dec. 22, 1962 22 p 3 refs In ITALIAN
(*Its* Nota Interna 177; LNF-62/111)

The dynamic behavior of the discriminator of a tunnel diode is described. Variations in the threshold of discrimination, under dynamic conditions, of less than 5% of the value of the static threshold are reported. A figure of merit (accuracy) is proposed. Trans. by P.F.E.

N63-16753 Motorola, Inc. Military Electronics Div., Scottsdale, Ariz.
DEVELOPMENT OF MILITARY SPECIFICATION MIL-T-23103 (WEP), GENERAL REQUIREMENTS FOR THE THERMAL PERFORMANCE EVALUATION OF AIRBORNE MILITARY ELECTRONICS EQUIPMENT
Jim Baum and Ray Jimenez *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1-4, 1962 Mar. 1963 p 38-48 (See N63-16750 14-01)

A program to define valid and useful measures of electronic equipment thermal design performance and to prepare a specification detailing thermal design evaluation procedures is summarized. The basic steps in such a specification program are: (1) making a detailed study of the equipment to identify heat-dissipating and critical parts, and electrical stresses for all parts, and to collect thermal data, (2) instrumenting the unit thermally and electrically by standardized procedures and monitoring critical parts, (3) carrying out performance limit testing, (4) reducing test data, (5) presenting the performance limit data in a standard format, and (6) presenting the thermal performance evaluation parameters in tabular form. D.E.R.

N63-16840 National Bureau of Standards, Washington, D.C.
ANALYSIS OF COAXIAL TWO-TERMINAL CONICAL CAPACITOR
M. C. Selby Apr. 6, 1962 20 p 31 refs
(NBS Monograph 46) GPO: $0.20

Adjustable capacitors having electrodes in the form of coaxial cones or frustums have been used on rare occasions in the past; but their potential superiority to other types of capacitors for some important applications have been overlooked. The advantage of this geometry over cylindrical or disk forms is that the practical capacitance range is several times larger. An example cites the capacitance ranges of a disk, cylindrical, and conical type to be 10, 40, and 168 to one, respectively. An approximate equation was derived for this conical capacitor, and close agreement is shown between computed and measured values of capacitance versus electrode displacement. Multiple cone and different shape electrodes are suggested to obtain large values of capacitance with an appreciable saving of space and further increased range of capacitance. The electric field is plotted, and its construction steps for axial symmetry are given. Author

N63-16851 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE DEVELOPMENT OF CONSISTENT APPROXIMATE RELATIONSHIPS FOR UNSYMMETRICAL SHORT CIRCUITS OF THE SYNCHRONOUS SALIENT POLE MACHINE [ENTWICKLUNG GESCHLOSSENER NAEHERUNGSBEZIEHUNGEN FUER UNSYMMETRISCHE STOSSKURZSCHLUESSE DER SYNCHRONEN SCHENKELPOL-MASCHINE]
L. Hannakam London, Ministry of Aviation, July 1962 47 p Transl. into ENGLISH from Arch. Elektrotech. (Berlin), v. 45, no. 2, 1960 p 118–156
(RAE Lib. Transl. 1001)

The voltage differential equations of a three-phase salient pole machine running at synchronous speed will be set up, whose stator winding is subjected to (1) a two-terminal short circuit (line-to-line short circuit), (2) an earth short circuit (single-phase line to neutral), (3) a double earth short circuit (two phases to earth, through neutral point), which can be solved by simple mathematical functions from a new approximation procedure. The transient courses of the currents flowing in the separate machine windings, the voltages appearing at the open phases, and the corresponding rotating torques of the salient pole machine will be found for the most unfavorable instant of switching from the stated approximation process by means of the step-by-step integration. (Runge–Kutta–Method) and the transient courses of the quantities compared. Author

N63-16866 Minnesota U. Electron Tube Research Lab., Minneapolis
STUDIES OF PRIMARY ELECTRON SOURCES Scientific Report No. 5, Mar. 1, 1962 to June 1, 1962
D. E. Anderson Jan. 1963 104 p 17 refs
(Contract AF 19(604)-8381)
(AFCRL-63-59)

This report includes: (1) studies of thermionic cathodes—controlled activation and deactivation of oxide cathodes, long pulse performance of oxide-coated cathodes, optical measurements of oxide cathodes, and coating thickness studies; and (2) studies of nonthermionic electron sources—thin film dielectrics of beryllium and aluminum oxide systems, magnesium oxide systems, tantalum–tantalum pentoxide–metal systems; and hot electron emission from superconductors. I.v.L.

N63-16867 Minnesota U. Electron Tube Research Lab., Minneapolis
STUDIES OF PRIMARY ELECTRON SOURCES Scientific Report No. 6, June 1, 1962 to Sept. 1, 1962
D. E. Anderson and W. G. Shepherd Jan. 1963 80 p 7 refs
(Contract AF 19(604)-8381)
(AFCRL-63-84)

A structure designed to expose an oxide cathode to a controlled Ba or Sr pressure is described, and results are presented. Simultaneous determination of photoelectric and thermionic emission energy-distribution measurements from BaO are used in an evaluation of the analyzer system. A measure of the potential profile in cathode undercurrent drain conditions is derived. Methods of formation of Al_2O_3 films for thin-film tunnel-current devices are compared; the electrical properties of the insulating films are shown to be insensitive to the anodizing techniques used. Preliminary measurements of electron emission from Al-Al_2O_3-Au devices are presented. Arc formation above a liquid-gallium pool cathode is discussed, and possible switching applications are suggested. Author

N63-16888 New York U. Coll. of Engineering, N.Y.
THE PERFORMANCE OF A BANK OF DOUBLE, ISOLATED, SYNCHRONOUSLY-TUNED FILTERS FOR RECOVERING TONE BURST TELEMETRY SIGNALS
Shepard Wenglin Jan. 25, 1962 7 p
(NASA Contract NAS5-408)
(Tech. Memo. 22; NASA-CR-50113) OTS: $1.10 ph, $0.80 mf

The performance of a bank of filters, each one of which is composed of two identical, isolated single-tuned circuits in cascade, has now been evaluated and compared with that of a bank of single-tuned filters. This filter will be referred to as a double-tuned filter. The performance of the double-tuned filter has been found to differ only slightly from that of the single-tuned filter. With respect to signal-to-noise ratio, the double-tuned filter is an average of approximately 0.5 db superior to the single-tuned filter; with respect to resolution signal-to-noise ratio, it is an average of approximately 0.85 db inferior to the single-tuned filter. Author

N63-16894 Airlines Communications Administrative Council, Airlines Electronic Engineering Committee, Washington, D.C.
AIRBORNE GLIDE SLOPE RECEIVER MARK-2
Washington, D.C., Aeronautical Radio, Inc., Mar. 1, 1962 11 p
(ARINC Characteristic No. 551)

The electrical and physical characteristics of an industry standard separate glide slope receiver are established so as to assure component and associated circuitry interchangeability. The standard pin connections and the connector type of an internal glide slope function to be used with the receiver are provided so a manufacturer may make the internal function interchangeable with an external glide slope receiver. Standards required to effect such interchangeability are: receiver form factor and connector type, power circuit wiring, provision for internal damping capacitors and super flag circuitry, interwiring and pin connection, weight, and pindexing (index pin arrangement). D.E.R.

N63-16932 Minnesota U. Electron Tube Research Lab., Minneapolis
STUDIES OF PRIMARY ELECTRON SOURCES Scientific Report No. 7, Sept. 1, 1962 to Dec. 1, 1962
D. E. Anderson Apr. 1963 109 p refs
(Contract AF 19(604)-8381)
(AFCRL-63-129)

The problem of an oxide cathode in barium vapor at low pressures is examined theoretically by applying the methods of irreversible thermodynamics. Preliminary data from a controlled barium vapor tube is presented and examined in terms of the derived quantities. Also, the photoelectric emission energy distributions obtained from a barium oxide coating are presented. Discussion includes: the possibility of obtaining thermionic emission from a barium sulfide cathode, the effects of aging, temperature dependence, and high current densities on aluminum–aluminum oxide-metal tunnel current devices, triode aluminum devices, electron emission from aluminum–aurelium thin film devices, and continuing studies of electron emission from superconducting field-emitters. D.E.R.

N63-16936 Illinois U. Electrical Engineering Research Lab., Urbana
RESEARCH STUDIES ON PROBLEMS RELATED TO ANTENNAS Quarterly Report No. 2, 1 Dec. 1962 to 28 Feb. 1963
James Rippin Apr. 15, 1963 53 p 65 refs
(Contract AF 33(657)-10474)

The observed properties of log-periodic antennas are experimentally and analytically investigated and are explained through their uniform periodic counterparts. It has been found that radiation patterns measured at frequencies in the stop-bands of uniform periodic dipole arrays are not always predictable from Brillouin diagrams, so attempts to measure the currents in each element of the array have been made. But this reduces the sensitivity of the

current probe and makes exact positioning of the probe relative to the elements of the array difficult. An improved mount for positioning the probe has been constructed and new measurements are being taken. D.E.R.

N63-16941 Airlines Communication Administrative Council. Airlines Electronic Engineering Committee, Washington, D.C.
AIRBORNE ADF SYSTEM— MARK 2
Washington, D.C., Aeronautical Radio, Inc., Mar. 1, 1962 25 p refs
(ARINC Characteristic No. 550)

Physical and electrical form factors and interwiring standards are established for a modernized automatic direction finder system. A description of the system and standards required to effect interchangeability are presented. Attachments are described. N.E.A.

N63-16944 Case Inst. of Tech., Cleveland, Ohio
LOGIC OF CONTROLLED THRESHOLD DEVICES
H. F. Klock, G. D. Kraft, and R. D. Haney Dec. 1962 187 p 26 refs
(RADC-TDR-62-498; EDC-6-62-1)

The work of various authors in the area of threshold logic is reviewed. The conditions for a Boolean function expressed in terms of And-Or connectives to be a threshold function are listed. The solutions to the single-stage and compound synthesis problems as given by several authors are presented. The two major unsolved problems of threshold logic synthesis are stated. The equivalence between a controlled threshold device and a general threshold device is established. A listing of the threshold logic realization of the switching functions of three variables is given. The Ordering Procedure of Coates and Lewis for threshold network synthesis is reviewed. Seventeen synthesis theorems are given. A minimum integer synthesis procedure is developed which is easily applicable for functions of four or fewer variables. A procedure for generating a Boolean function in And-Or connectives from a given set of weights and a threshold level is given. Several synthesis examples are worked out in detail. The rudiments of a digital computer under construction which uses threshold logic are presented.
Author

10 FACILITIES

Includes: airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations.

For related information see: 06 Auxiliary Systems.

N63-16357 India. Dept. of Atomic Energy, Bombay
Brief Annual Report 1962-1963 [RESEARCH AND DEVELOPMENT OF ATOMIC ENERGY IN INDIA]
1963 23 p

The organization and facilities of the Indian atomic energy commission are outlined. Included are: the atomic energy establishment, Trombay, the Tarapur atomic power project, Rajasthan atomic power station, future atomic power stations, the atomic minerals division, the Jaduguda mines, industrial operations, international relations, space research, architecture and civil engineering division, the Tata Institute of fundamental research, and miscellaneous institutions and activities. D.E.R.

N63-16394 Stanford U., Calif.
A CENTRIFUGAL HYPERSONIC WIND TUNNEL FACILITY FOR INVESTIGATING EFFECTS OF INERTIA ON ABLATING BODIES Technical Report No. 5
J. S. Ford and W. H. Horton Mar. 1963 43 p 16 refs
(Contract Nonr-225(30))
(SUDAER-151)

Since it can be demonstrated that the effects of inertial forces on a viscous ablating layer are as important as the effects of shear forces, the process of ablation must be as dependent upon the deceleration of the body as upon the flow conditions. It is feasible then to construct a facility to examine these deceleration effects and the accompanying inertial loads in high-velocity, high-enthalpy gas flow. The conclusion is reached that a centrifuge mounted, electric arc heated, hypersonic tunnel can be developed with the necessary capability for studies over a wide range of trajectories, and the design essentials for such a wind tunnel are presented. D.E.R.

N63-16402 Massachusetts Inst. of Tech. Engineering Projects Lab., Cambridge
DESIGN CONSIDERATIONS AND METHODS FOR LOW-DENSITY WIND TUNNELS OPERATING WITH HIGH STAGNATION TEMPERATURES [Final Report] 1962
G. A. Brown and A. E. Bergles Wright-Patterson AFB, Ohio, Directorate of Eng. Test, Apr. 1963 149 p 56 refs
(Contract AF 33(616)-6582)
(ASD-TDR-63-154)

A study was made of design techniques for low-density wind tunnels operating with high stagnation temperatures and hypersonic flow. An approximate boundary-layer analysis was developed to predict feasible ranges of operating conditions for low-density wind tunnels. Detailed calculations were made for three nozzles, including boundary-layer corrections for isentropic contours. It appears that unless an enormous amount of money is devoted to the construction of an extremely large, low-density wind tunnel, it will never be feasible to test large models so that Knudsen numbers in the free-molecular-flow range are produced. Author

N63-16475 Avco Corp. Research and Advanced Development Div., Wilmington, Mass.
INVESTIGATION OF THERMAL IMAGING TECHNIQUES Final Report
Tibor S. Laszlo and Paul J. Sheehan, Jr. Mar. 15, 1963 102 p 21 refs
(Contract AF 19(604)-7204)
(AFCRL-63-73; RAD-TR-63-7)

Experiments and measurements which can be performed successfully in image furnaces are listed together with the necessary special instrumentation. The restrictions imposed by basic principles of image furnaces upon their operation are discussed, and methods to overcome these restrictions are proposed. Sample holders were designed and built which permit operation in controlled atmospheres with rotation of the sample on, or perpendicular to, the optical axis, and which are suitable for the measurement of electrical properties at high temperatures. A fast action, on–off shutter has been designed to be operated by compressed air and vacuum. A new guidance-control system has been built which has greater sensitivity and precision than the previous model. An experimental setup has been constructed for the direct measurement of solar reflection coefficients. A 36-inch paraboloidal reflector has been fabricated by a new method. A method has been developed which makes it possible to calculate the temperature dependence of a property from measurements of the uneven flux distribution of the image at several peak-flux values. Blackbody cavities are discussed, and a new shape black-body is presented which absorbs a larger portion of the incident radiant energy than previously known shapes. Analytical evaluation for this shape was made and compared with results for previously known shapes. A calorimeter was built using this shape and fluxes in the solar furnaces were measured with it. The resultant correlation of

normal-incidence solar radiation and the concentrated flux in the focal area is presented. The use of the solar furnace as a high-intensity radiant-flux standard is proposed. The flux distribution was measured with a fine resolution radiometer using MgO-coated absorbing surface. A method for the determination of the sensitivity of the radiometer using a single flux measurement has been developed. Photomicrographs of high-melting-point ceramics, melted in the rotating sample-holder, are presented. Single crystals of thoria grown by vapor condensation are shown. A method for the measurement of the electrical resistivity of refractory oxides was developed. A survey of image-furnace facilities has been made. Author

N63-16574 Army Dept. Office of the Chief of Engineers, Washington, D.C.
UTILIZATION OF NUCLEAR POWER PLANTS IN UNDERGROUND INSTALLATIONS
Apr. 15, 1963 43 p 30 refs
(EM-1110-345-950)

This manual provides information on nuclear power sources for underground installations that might be required to operate in a completely closed or isolated situation for a period of time. The selection criteria for power generators include heat rejection, geographic elevation, vulnerability, ruggedness, compactness, fuel supply, operation and maintenance, and economy. Nonnuclear powerplants, (such as diesel, gas turbine, and fossil fueled steam plants) have the major disadvantages of requiring large fuel storage facilities, and surface connections for air intake and exhaust gas expulsion. Nuclear powerplants overcome these disadvantages and, in addition, offer reduced noise and vibration levels, inherent ability to follow load requirements, minimum fuel resupply, and reduction of the wartime national demand for petroleum products. The current disadvantage of nuclear power is high initial cost. Support facilities, logistic considerations, site characteristics, heat sinks, and projected lifetime of nuclear powerplants are discussed, and a general description of available and projected Army nuclear powerplants is presented. The requirements unique to nuclear powerplants are discussed, including shielding, personnel psychology, containment of possible accidents, and radioactive waste disposal. M.P.G.

N63-16724 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ESTIMATED 1963-1970 CAPABILITY OF THE DEEP SPACE INSTRUMENTATION FACILITY FOR APOLLO PROJECT
E. Rechtin Feb. 1, 1962 54 p 8 refs
(NASA Contract NASw-100)
(EPD-29, Rev. 1; NASA-CR-50001) OTS: $5.60 ph, $1.82 mf

The capabilities of the Deep Space Instrumentation Facility (DSIF) in providing a precision tracking and communications system for the Apollo Project from 1963 to 1970 are discussed. The DSIF at present is composed of three Deep Space Stations spaced at approximately equal intervals of longitude around the earth and a mobile station, together with the necessary intersite communications links. DSIF systems are discussed in terms of (1) existing facilities, (2) authorized and funded projects, (3) proposed but not funded projects, and (4) tentative projects. M.P.G.

N63-16752 Aeronautical Systems Div., Air Force Systems Command, Wright-Patterson AFB, Ohio
ENVIRONMENTAL TESTING STANDARDIZATION VIA MIL-STD-810 ENVIRONMENTAL TEST METHODS FOR AEROSPACE AND GROUND EQUIPMENT
Virgil J. Junker *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 34–37 (See N63-16750 14-01)

An urgent need for the upgrading and standardization of test procedures and criteria in the Air Force has been met by the development of MIL-STD-810. This paper explains the purpose of the standard, what it is and what it is not, and the way in which it was developed. The test methods of this standard apply broadly to all items of aerospace and ground equipment except airframes and primary powerplants. Author

N63-16758 Martin Co., Denver, Colo.
THE USE OF MEASURED DATA FOR ESTABLISHING HARDWARE DESIGN CRITERIA FOR PRIMARY GROUND SUPPORT STRUCTURES
H. L. Cox, R. O. Winter, and W. A. Benfield *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments–Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 98-122 5 refs (See N63-16750 14-01)

This paper points out how measured data for full-scale structures were applied to rewriting existing design and test criteria, and also how the data were utilized in preparing new structural-design criteria for possible follow-on programs. Author

N63-16760 General Electric Co., Schenectady, N.Y.
SYSTEMS EVALUATION AND THE TRADITIONAL ROLE OF THE TESTING LABORATORY
R. G. Yaeger *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 137–143 (See N63-16750 14-01)

The position of the systems test in the development of new space hardware is discussed after the systems test has been defined. A new test operation is described in which the developmental steps are: conceptual design, actual design, component evaluation, systems evaluation, and demonstration. This test operation has the advantages of using personnel to a better advantage, giving superior test methods and results and better environmental simulation, and saving valuable test hours. D.E.R.

N63-16762 MB Electronics. Div. of Textron Electronics, Inc., New Haven, Conn.
RELATIONSHIPS BETWEEN RANDOM VIBRATION TESTS AND THE FIELD ENVIRONMENT
G. B. Booth *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 164–171 5 refs (See N63-16750 14-01)

On the hypothesis that vibration tests of greatly differing character can only be compared in terms of the responses of elements of typical devices to these tests, computations are made for these responses and for the desired responses to ideal tests. For band-equalized random-vibration systems, the computed responses are compared to the desired responses for various specimen to vibration-exciter mass ratios, specimen damping factors, and frequency to control bandwidth ratios. For sweep random systems, the achievable accuracy is discussed and shown to be of the same order as accuracies achievable by band-equalized systems. A hybrid system, incorporating a few peak-notch equalizers in addition to the multiband control, overcomes the deficiencies of band-equalized systems. The reliability of equipment tested by band-equalization systems having large control bandwidths is questionable. Author

N63-16763 Boeing Co. Aero-Space Div., Seattle, Wash.
MULTI-PLANE VIBRATION TESTING TECHNIQUES
Stanley Baber and Earl J. Wilson *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 172–180 3 refs (See N63-16750 14-01)

Three methods of combining three planes of vibration into a single test are discussed. Vibration-monitor locations, instrumentation, and presentation of data required for multiplane vibration tests are described. It is shown that more data are required before this technique can become a universal tool. Author

N63-16765 Temco Electronics, Dallas, Tex.
THE USE OF A VACUUM TECHNIQUE FOR ATTACHING A TEST FIXTURE TO A VIBRATION EXCITER
C. D. Robbins *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D. C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 189–193 (See N63-16750 14-01)

A method for attaching a vibration fixture to an exciter by means of a vacuum suction rather than the conventional bolt-tapped hole method is presented. This method cuts down on the time consumed in repetitive testing. The method was developed in conjunction with the testing of the hydraulic servocylinders of the first three stages of the Minuteman ICBM. D.E.R.

N63-16766 Air Force Missile Development Center, Holloman AFB, N. Mex
COMBINED ENVIRONMENTAL TESTING OF THE HOLLOMAN TRACK
L. M. Bogard *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 194–201 (See N63-16750 14-01)

The combined vibration and sustained-acceleration environment of the Holloman Track have pointed out system failures which had not been detected by sequential laboratory tests. The capabilities of the high-speed track and the favorable results of the track testing are discussed and a number of examples are given. Author

N63-16769 Sandia Corp., Albuquerque, N. Mex.
SHOCK TEST METHODS VERSUS SHOCK TEST SPECIFICATIONS
R. O. Brooks *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 224-235 3 refs This paper was not presented at Symp. (See N63-16750 14-01)

Current shock-test shortcomings are discussed, and some techniques are presented to aid the designer and test engineer in evaluating component shock-test data. Author

N63-16771 Lord Mfg. Co., Erie, Pa.
SUSPENSION SYSTEM DESIGN TO REDUCE HIGH INTENSITY SHOCK
J. T. Gwinn, Jr. *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Paper from] 31st Symp. on Shock, Vibration and Assoc. Environments–Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 245–256 9 refs This paper was not presented at Symp. (See N63-16750 14-01)

This paper presents basic concepts that must be recognized and used in design of resilient suspensions to attenuate high-intensity shock. The theoretical response of a given system may be calculated from measured test data for the Navy Hi-Impact Shock Testing Machine and known fragility data for the equipment to be protected. Such a design problem is reviewed. Actual test data taken during shock testing of the system is compared to the calculated response and proves the design approach. Author

N63-16774 Garrett Corp. AiResearch Mfg. Div., Phoenix, Ariz.
A COMPARISON BETWEEN A "SLIPPERY TABLE" AND A "SLICK TABLE" FOR HORIZONTAL VIBRATION TESTING
C. J. Mc Kenzie *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 303–305 2 refs (See N63-16750 14-01)

An approach that uses grease instead of the usual oil film as a lubrication medium and the benefits of the derived "slick table" operation in horizontal vibration testing in reducing vertical flexure are described. Results of this operation are that: vertical "cross-talk" of the slider plate is reduced in the frequency range of 5 to 2000 cps; the slider plate and driver plate are easy to align; wear rates are reduced; slider plates can be fabricated from aluminum or magnesium materials, the "slick table" is capable of supporting a heavier payload than the "slippery table" without breakdown of the film; exciter power requirements are comparable for shearing an oil film or a grease lubricant; and a cleaner testing area environment is experienced. D.E.R.

N63-16785 Rocket Power, Inc., Mesa, Ariz.
PYROTECHNIC OUTSIDE WARNING SYSTEM Final Report—Phase I
Mar. 1963 131 p
(Contract OCD-OS-62-76)
(Rept. 7606-A)

The design criteria and characteristics of a mass, low-cost outdoor alert system which can provide instant audible and visual warning, day or night, are outlined. The development of new components for flare warning devices, using solid propellants for the delay train, explosive charge, and flare, as well as for the rocket motor, is detailed and the successful completion of the first, or design, phase of the pyrotechnic outside warning system is noted D.E.R.

N63-16844 Federal Aviation Agency. Systems Research and Development Service, Washington, D.C.
F.A.A. PERSONNEL—DEPLOYMENT ORGANIZATION COST Preliminary Report
June 1963 53 p

This report represents the second in a series of preliminary studies being prepared in support of a comprehensive program to re-examine all of the services which the Federal Aviation Agency provides, with the intent of configuring the facilities and personnel deployment in a way which makes the best overall use of the available resources. I.v.L.

N63-16857 Air Force Missile Development Center, Holloman AFB, N. Mex.
CENTRAL INERTIAL GUIDANCE TEST FACILITY LABORATORY STANDARDIZATION EFFORTS
Jerald D. Miller *In its* Proc. of the AFMDC Inertial Guidance Test Symp., Vol. I, Holloman AFB, 16–17 Oct. 1962 p III-1–III-12 (See N63-16854 14-01)

It has been found that the standardization of testing and test measurements at the central inertial guidance test facility laboratories had led to: (1) a shortening of testing time, (2) a simplification of test procedures, (3) a simplification of data reduction, (4) a clarification of communications, and (5) a simplification of data correlation and comparison. Continued efforts toward standardization of testing are outlined. D.E.R.

N63-16945 Air Force Dept., Washington, D.C.
MILITARY STANDARD ENVIRONMENTAL TEST METHODS FOR AEROSPACE AND GROUND EQUIPMENT
June 14, 1962 66 p
(MIL-STD-810 (USAF))

Uniform methods of environmental testing are given for determining the resistance of aerospace and ground equipment as to the effects of natural and induced environments peculiar to military operations. The formation and performance of tests, and the application of the test methods are presented. These test methods are to: (1) simulate actual service conditions, (2) reproduce consistent test results, and (3) serve as a guide for preparation of environmental test portions of detailed specifications. C.L.W.

11 FLUID MECHANICS

Includes: boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow, 03 Aerodynamics of Wings and Control Surfaces; 13 Heat Transfer; and 24 Physics, Plasma.

N63-16348 Netherlands Ship Model Basin, Wageningen
ON THE GROWTH OF NUCLEI AND THE RELATED SCALING FACTORS IN CAVITATION INCEPTION Laboratory Memorandum V 2
F. van der Walle [1962] 60 p 10 refs

A mathematical model has been formulated for the growth of nuclei that are transported in the flow around profiles. In addition, the formation of nuclei from crevices in the surface has been treated. The various scaling laws have been derived for the different types of cavitation mechanisms. Results of numerical calculations have been given for the inception values of the cavitation number for hemispherical bodies. The results are discussed and compared with already published experimental data. Author

N63-16349 Illinois U., Urbana
THERMAL ELECTRIFICATION AND IONIZATION OF SOLID PARTICLES Technical Report
S. L. Soo Charlottesville, Va. U. School of Eng. and Applied Sci., Apr. 1963 26 p 9 refs Submitted for Publication
(Contract Nonr 3623(00); Proj. Squid)
(111-10-P)

Distribution of an electron cloud around a solid particle charged by thermal electrification was studied. The case considered includes a solid particle in a finite volume consisting of a vacuum or a gas-filled environment. It was shown that most of the electrons emitted by thermionic emission are bounded by the charge of the solid particle. Ionization of this system can be produced by an electromagnetic field or scattering by gas molecules. Author

N63-16375 Deutsche Versuchsanstalt für Luft- und Raumfahrt. Inst. für Flugtreib- und Schmierstoffe, Munich (W. Germany)
RELATIONSHIPS BETWEEN PROPERTIES AND EFFICIENCIES OF JET PROPULSION LIQUID FUELS (BEZIEHUNGEN ZWISCHEN EIGENSCHAFTEN UND LEISTUNGEN VON KRAFTSTOFFEN FÜR LUFTSTRAHLANTRIEBE)
G. Spengler, M. Zimmer, and H. Gemperlein Nov. 1962 53 p 14 refs In GERMAN
(DVL-210)

A chemical-physical analysis is made of the thrust of various fuels introduced into a small measuring combustion chamber. Heat treatment data is summarized and the influence of combustion behavior is ascertained. A partial combustion method is used to determine the output characteristics. Trans. by J.A.J.

N63-16393 Stanford U., Calif.
EFFECTS OF GEOMETRY AND UNIDIRECTIONAL BODY FORCES ON THE STABILITY OF LIQUID LAYERS Technical Report No. 4
Max Anliker and Wen-Yi Shih Pi Mar. 1963 47 p 15 refs
(Contract Nonr-225(30))
(SUDAER-150)

The stability of liquid layers with a prescribed interface geometry in the presence of a surface tension and unidirectional body force is investigated theoretically by means of a small vibrational analysis. The fluid of the layers is assumed to be incompressible and inviscid and the flow irrotational. Particular emphasis is given to the stability of such layers. They are studied by means of a semi-inverse method which allows the exact determination of particular eigenvibrations. It is shown that the variations of the thickness of a fluid layer may significantly influence its stability, especially for body forces in the near-zero region. The results also reveal that for some solid supporting surfaces, layers of the type considered are only stable if the body forces are larger than a certain positive value, whereas for other surfaces, stability prevails as long as the body forces exceed a certain negative limit value. This fact may be utilized in the design of containers of fluid for near-zero gravity conditions in such a manner that the fluid adheres to a certain area of the container. N.E.A.

N63-16406 RAND Corp., Santa Monica, Calif.
THE TURBULENT BOUNDARY LAYER IN A COMPRESSIBLE FLUID
D. E. Coles Sept. 1962 81 p 96 refs
(Contract AF 49(638)-700; Proj. RAND)
(R-403-PR)

A point of departure is provided for physicists and boundary-layer specialists interested in the effects of heat and mass transfer in turbulent boundary layers, especially in high-speed flight. First, a transformation that reduces the boundary-layer equations for compressible two-dimensional mean turbulent motion to incompressible form is developed. This transformation is then applied to the special case of the adiabatic turbulent boundary layer on a smooth wall. Thus, the mean pressure and velocity can be measured, the mean acceleration of the fluid can be determined, and the shearing stress defined as the stress necessary to account for this acceleration. Then the formula leads to a general transformation valid for laminar or turbulent flow in wakes and boundary layers. Appendices contain a manual of experimental boundary-layer practice for low-speed flow, and a bibliography of related analytical literature. D.E.R.

N63-16407 Brown U., Providence, R.I.
THE VISCOSITY OF ARGON-HELIUM MIXTURES
H. Iwasaki and J. Kestin Virginia U., Charlottesville, School of Eng. and Applied Sci., Apr. 1963 53 p 13 refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(BRN-4-P)

This paper describes the details and results of a precise, absolute determination of the viscosity of argon–helium mixtures at 20° C and at 30° C, both from 1 to 50 atm pressure. The accuracy of the measurements is estimated to be ±0.2% at worst, but the relative values with respect to the pure gases are thought to be

precise to ±0.04%. It is found that the excess viscosity of all mixtures is a unique function of density, ρ, certainly to order ρ, and approximately, but with an error comparable to that of the determination, also to order ρ^2. Author

N63-16408 Brown U., Providence, R.I.
THE VISCOSITY OF CARBON DIOXIDE IN THE NEIGHBORHOOD OF THE CRITICAL POINT
J. Kestin, J. H. Whitelaw, and T. F. Zien Virginia U., Charlottesville, School of Eng. and Applied Sci., Apr. 1963 46 p 15 refs Submitted for Publication
(Nonr 3623(00); Proj. Squid)
(BRN-5-P)

This paper contains the results of a new determination of the viscosity of carbon dioxide in the single-phase region surrounding the critical dome. The determination was performed in a modified oscillating-disk viscometer. The results show that the anomalies in the dynamic viscosity of carbon dioxide are rather mild, and several orders of magnitude lower than those reported by A. Michels, A. Botzen and W. Schuurman. The kinematic viscosity, however, exhibits a region of very rapid change with pressure at constant temperature. An attempt was made to provide a very crude estimate of the effect of density stratification in the terrestrial gravitational field in the neighborhood of the critical dome. Author

N63-16465 Naval Weapons Lab. Computation and Analysis Lab., Dahlgren, Va.
ROTATING FLOWS NORMAL TO A FLAT SURFACE
Ernst W. Schwiderdki and Hans J. Lugt Apr. 1963 57 p 15 refs
(NWL-1853)

Numerical solutions of three-parameter vortex flows over flat surfaces, and of rotating flows of von Kármán's and Bödewadt's types are presented for a variety of Reynolds numbers. The results have been obtained on the basis of an extended boundary-layer theory, which allows a reduction of the Navier–Stokes equations to a set of Volterra integral equations. The new flows are in good agreement with available physical observations. Author

N63-16491 Aerospace Corp. Aerodynamics and Propulsion Research Lab., El Segundo, Calif.
A SOLUTION FOR THREE-DIMENSIONAL VORTEX FLOWS WITH STRONG CIRCULATION
W. S. Lewellen Mar. 20, 1962 56 p 12 refs
(Contract AF 04(647)-930)
(DCAS-TDR-62-77; TDR-930(2210-14)TN-1)

The Navier–Stokes equations for a viscous, incompressible fluid are considered for a steady, axisymmetric flow composed of a strong rotation combined with radial sink flow which exhausts axially inside a finite radius. The equations are reduced to two coupled partial differential equations in terms of the stream function and circulation. The equations contain three dimensionless parameters: the radial Reynolds number, a characteristic ratio of mass flow per unit length to circulation, and a characteristic ratio of an axial dimension to a radial dimension. The product of these last two dimensionless parameters is used as a new expansion parameter for generating an asymptotic series solution. To zeroth-order in this parameter, the solution for the stream function is a linear distribution between two axial boundary values. First-order correction terms are calculated for a specific example. Author

N63-16494 Massachusetts Inst. of Tech. Fluid Mechanics Lab., Cambridge
FREE-MOLECULE FLOW IN THE AXIAL-FLOW TURBO-VACUUM PUMP Final Report
John S. Maulbetsch and Ascher H. Shapiro Mar. 1963 83 p 9 refs
(Contract Nonr-1841(55))
(Publ. 63-3)

The rarefied gas flow through a moving cascade of flat plates was investigated analytically and experimentally, with the application in mind of high-vacuum pumping. The theory is based on the assumption of free-molecule flow, i.e., no collisions between molecules. The essential quantities determining the performance of a blade row are the net transmission probabilities from one side to the other. These transmission probabilities depend mainly on the blade angle and spacing-chord ratio, and on the ratio of mechanical speed to mean molecular speed. In this report, the transmission coefficients are calculated by numerical solution of the governing integral equations, and are compared with the results of earlier Monte Carlo calculations. Experiments with a rotating test machine, having either a single rotor or a rotor followed by a stator, gave results in good agreement with the theory. A special means was developed for testing stationary cascades under conditions simulating the operation of a moving rotor. This apparatus was tested with several blade geometries. The results confirmed both the theory and the feasibility of the new rarefied gas wind-tunnel concept. Author

N63-16506 California U., Berkeley. Lawrence Radiation Lab.
LIQUID-LIQUID INTERFACIAL-TENSION MEASUREMENT WITH AN OSCILLATING JET
Alfred E. Vandegrift, Peter N. Tenney, and Theodore Vermeulen Mar. 11, 1963 105 p 38 refs
(Contract W-7405-eng-48)
(UCRL-10717) OTS: $2.25

In this study the oscillating-jet technique, which has been used for some time to measure both the static and dynamic surface tension between a gas and a liquid, has been extended to the measurement of the interfacial tension between two immiscible liquids. In the present application, both a theory and new experimental techniques have been developed. This work was undertaken in order to obtain a method of studying interfacial concentrations in liquid-liquid systems undergoing mass transfer; progress has been made toward this goal. Author

N63-16511 Avco-Everett Research Lab., Everett, Mass.
HYDRODYNAMIC EFFECTS PRODUCED BY PULSE MICROWAVE DISCHARGES
S. C. Lin and G. P. Theofilos Oct. 1962 47 p 11 refs
(Contract AF 19(604)-7458)
(Avco-Everett Res. Rept.-138; AFCRL-63-126)

An elementary theory is developed for predicting the strength of pressure waves to be expected from sudden breakdown of a gas by high-frequency electromagnetic waves in a one-dimensional geometry. It is shown that for an uncontrolled breakdown where the local field strength is not carefully matched to the instantaneous plasma condition to avoid strong reflections, the heating effect will be self-limiting and the resultant shock strength depends only on the incident wave frequency and on the initial gas density. Numerical example for microwave breakdown in air indicates that at normal sea-level density, the shock wave accompanying the breakdown is generally quite weak (of the order of Mach 1.1 at 100 gc/s frequency). However, for breakdown at lower air densities, stronger shock waves can be anticipated. Preliminary experimental observations of pressure waves generated in a one-dimensional channel by pulse microwave discharges tended to confirm the general features of the elementary theory, but showed somewhat stronger effects than predicted. Author

N63-16542 Maryland U., College Park
THE TRANSITION PROCESS IN A BOUNDARY LAYER ON A FLAT PLATE
John Albert Nutant (Ph.D. Thesis) 1963 87 p 27 refs
(Contract AF 49(638)-645; Grant AF-AFOSR 140-63)

Detailed observations are made of the flow field in the transition region in a boundary layer of approximately 1-in. thickness on

a flat plate mounted in a long running-water channel by the use of the pulsed hydrogen-bubble visualization technique. Small perturbations are introduced in the flow by a rubber sheet bulging in and out. The rubber sheet is mounted flush with the plate surface. Following the amplification of the originally two-dimensional wave, the wave front becomes warped, acquiring a longitudinal vorticity component along its swept-back front. The longitudinal vorticity component becomes rapidly concentrated to form a $\wedge$-shaped vortex. This primary $\wedge$ vortex creates a strong upward fluid motion along and inside the legs and a high-shear layer is formed. The high-shear layer breaks down to form an extremely concentrated discrete vortex, which subsequently develops into a hairpin shaped vortex. A complicated tangling occurs at the neck of the hairpin vortex resulting in turbulence. The breakdown of the high-shear layer produces as many as four of these hairpin vortices. Author

N63-16547 Linde Co. Div. of Union Carbide Corp., Tonawanda, N.Y.

RESEARCH STUDY OF THE CRYOTRAPPING OF HELIUM AND HYDROGEN DURING 20° K CONDENSATION OF GASES—PHASES I AND II

R. A. Hemstreet, D. J. Webster, D. M. Ruttenbur, W. J. Wirth, and J. R. Hamilton Arnold Engineering Development Center, May 1963 109 p 21 refs

(Contract AF 40(600)-945)

(AEDC-TDR-63-127)

A study of the variables affecting cryotrapping of helium and hydrogen during 20° K condensation of oxygen and nitrogen is presented. The mechanism of helium trapping appears to involve burying helium atoms in the solid oxygen or nitrogen. The process is most efficient at high condensation rates, but is not likely to find application for the removal of helium in a large space chamber. Experimental results indicate that hydrogen trapping occurs by adsorption of hydrogen molecules on the surface of the solid oxygen or nitrogen, and is most efficient at low condensation rates and low heat flux to the solid surface. These conditions indicate that hydrogen trapping may be applicable for hydrogen removal in a large space chamber. The trapping of hydrogen by nitrogen condensed on a 20° K surface has been studied under conditions where the surface was shielded from ambient-temperature radiation. The process is shown to be an inefficient means for hydrogen pumping, and is likely to have value only as a bonus in the operation of a large space chamber. Hydrogen trapping by methane, some simple fluorocarbons, and carbon dioxide condensed on a 20° K surface not shielded from ambient-temperature radiation has been studied. CCl_2F_2 and carbon dioxide show rather large capacities for hydrogen and may be useful for the pumping of hydrogen in a space chamber and in special applications. Author

N63-16549 Harry Diamond Labs., Washington, D.C.

FLUID AMPLIFICATION. 10. USE OF THE HYDRAULIC ANALOGY IN THE STUDY OF FLUID-INTERACTION DEVICES

Ralph G. Barclay, Allen A. Bowers, and John G. Moorhead Apr. 15, 1963 48 p 1 ref

(TR-1098)

The advantages of using the hydraulic analogy to study compressible gas flow in fluid-interaction devices are discussed. The mathematical basis of the analogy is summarized, and limitations in its use are pointed out. Various practical aspects concerning operation of an analogy facility are reviewed. Four hydraulic-analogy studies are briefly described: subsonic diffuser performance, three-stage closed-system bistable fluid-flow amplifier performance, quantitative measurement of switching flow required by a bistable fluid amplifier, and blocked-output-channel and stream-attachment characteristics in fixed and adjustable models of bistable elements. Abstracts of seventeen references regarding the theory and application of the hydraulic analogy are given. Author

N63-16556 Mound Lab., Miamisburg, Ohio

THE VAPOR-LIQUID EQUILIBRIUM OF DILUTE SOLUTIONS OF POLONIUM IN LIQUID BISMUTH

E. F. Joy May 15, 1963 31 p 30 refs

(Contract AT(33-1)-GEN-53)

(MLM-987) OTS: $0.75

The vapor-liquid equilibrium of dilute solutions of polonium in liquid bismuth has been determined between 450° to 850° C. The relative volatility, α, of liquid polonium-bismuth mixtures was determined by the Langmuir method and the Knudsen method. Equations are presented for the vapor pressure, P_{Bi}, of bismuth, the volatility, V_{Po}, of polonium, and the activity coefficient, γ, of polonium, where T is in ° K. Author

N63-16601 National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio

EXPERIMENTAL INVESTIGATION OF THE SLOSH-DAMPING EFFECTIVENESS OF POSITIVE-EXPULSION BAGS AND DIAPHRAGMS IN SPHERICAL TANKS

Andrew J. Stofan and Irving E. Sumner Washington, NASA, June 1963 20 p 10 refs

(NASA TN-D-1712) OTS: $0.50

An experimental investigation was conducted to evaluate the slosh-damping effectiveness of positive expulsion bags and diaphragms in spherical tanks ranging in size from 9.5 to 32 inches in diameter. The scaling effects for sloshing forces and damping ratios were determined for the butyl rubber positive-expulsion devices tested. The maximum slosh forces that occur at the first natural-mode frequency increased with an increase in excitation amplitude and decreased as the diaphragm material thickness increased. The damping ratio (or logarithmic decrement) was found to be essentially independent of the excitation amplitude and increased with an increase in diaphragm material thickness. The second natural-mode force peak and the fluid swirl at the natural-mode frequencies, which were observed for the unrestricted liquid sloshing, were completely suppressed. Author

N63-16607 Army Missile Command. Structures and Mechanics Lab., Redstone Arsenal, Ala.

THE PROPAGATION OF SHOCK WAVES INDUCED BY UNDERGROUND EXPLOSIONS

Dietrich E. Gudzent *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 61–70 (See N63-16603 14-34)

This paper presents a survey of the current status of investigations concerned with some of the fundamental problems involved in determination of efficient underground structures. The application of results from such studies is critical in the design of such things as bomb shelters, missile storage silos, highway construction, and mining operations. Information has been drawn from many sources: explosions of mining operations, theoretical studies, earthquakes, experimental nuclear explosions, and many small-scale laboratory experiments. In addition to studies devoted predominantly to soils and the nature of the transmission of waves through them, a theoretical effort has been expended in attempts to establish equations of motion for the propagation of shock waves through solid bodies. A number of theoretical approaches to the particular problem of establishing mathematical models for shock wave propagation are discussed. Some discussion of experimental work in terms of tests and a determination of scaling laws is given. Author

N63-16682 General Dynamics/Convair, San Diego, Calif.
RESEARCH ON COAXIAL JET MIXING Technical Report
Riley E. Cruse and Remo Tontini Nov. 1962 69 p 8 refs
(Contract Nonr 2854(00))
(GD/C 62-354A)

The subsonic, turbulent mixing of two unheated coaxial jets under constant-pressure conditions was studied. A method was developed for the design of constant-pressure mixing tubes with arbitrary velocity and area ratio; this method consists of determining the jet configuration and applying mass and momentum conservation equations to determine tube contour. A method was also developed for calculating the effective mixing-length parameter from the experimental tube dimensions using the equations of motion. The results indicate that the momentum transport mixing-length theory is not valid for predicting the general shape of a round jet in a moving stream, except for a jet issuing into a stream approaching zero velocity. M.P.G.

N63-16683 Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge
VELOCITY CORRELATION MEASUREMENTS IN THE MIXING REGION OF A JET
Marc A. Kolpin Mar. 1963 21 p 1 ref
(NASA Grant NsG-31-60)
(ASRL-TR-1008; NASA-CR-50192) OTS: $2.60 ph, $0.83 mf

Measurements of space–time correlations of the u-component of turbulence in the mixing region of a jet are presented. It is shown that the longitudinal correlation function

$$R = \frac{[U(x,t)\ U(x+\Delta x,t+\tau)]}{U'(x,t)\ U'(x+\Delta x,t+\tau)}$$

depends only upon the nondimensional quantities $\tau'' = \tau\ U_{exit}/x$ $\Delta\xi/\xi$ where $\xi = x/d$. On the cylinder $r = d/2$ the convection speed of the turbulent field was different for the different eddy sizes, varying from the local mean-speed for small eddies to $1/2\ U_{exit}$ for the large eddies. The lateral correlation function for zero time delay is shown to be of the from $R_\eta = R_\eta(\Delta\eta/\xi$ where $\eta = |r - d/2)/x|$ and is monotonically decaying with increased wire separation. Measurements of the angular correlation function are reported which show no correlation of the fluctuations across the diameter of the jet. Author

N63-16719 Maryland U., College Park
SELECTIVE ESCAPE OF GASES
E. J. Opik (Armagh Obs., Northern Ireland) [1962] 34 p 14 refs
Submitted for Publication
(NASA Grant NsG-58-60)
(NASA CR-50014; Tech. Rept. 276) OTS: $3.60 ph, $1.22 mf

Formulae for gas-kinetic escape of neutral and ionized gas from celestial bodies are set up, free from usual simplifications and applicable to the highest rates. It is shown that the isothermal model with a constant escape lifetime becomes physically meaningless when the atmospheric mass exceeds a certain, quite modest, limit and the exospheric base disappears; this defines an overall upper limit to the rate of gas-kinetic escape from a body of given mass; the limit is rather low, by cosmic standards. Absolute upper limits to selective escape are calculated. Author

N63-16722 United Aircraft Corp. Research Labs., East Hartford, Conn.
RESEARCH ON THE COLLISION PROBABILITIES OF ELECTRONS AND CESIUM IONS IN CESIUM VAPORS Quarterly Status Report No. 4, Feb. 1, 1963 through Apr. 30, 1963
R. H. Bullis and R. K. Flavin Apr. 30, 1963 8 p
(NASA Contract NASr-112)
(NASA-CR-50049; A-920057-4) OTS: $1.10 ph, $0.80 mf

Progress in the electron collision experiment has been in the formulation of a two-term expansion for the collision frequency to represent the velocity dependence and the acquisition of experimental data. Measurements are underway to determine the collision cross section at higher energies, using a resistive heating technique to increase the cesium vapor temperature in the waveguide. Author

N63-16732 National Bureau of Standards, Boulder, Colo.
THE VAPOUR PRESSURE OF 20°K EQUILIBRIUM HYDROGEN
L. A. Weber, D. E. Diller, H. M. Roder, and R. D. Goodwin Repr. from Cryogenics, v. 2, no. 4, June 1962 p 1–3 9 refs
(NASA Order R-45)
(NASA-CR-50159; NBS-R-236)

Results of a program to determine the volumetric, thermodynamic, and transfer properties of 20° K equilibrium hydrogen (*para*-hydrogen) are presented. Thirty-eight experimental datum points were obtained along the vapor pressure curve between the boiling point (20.268° K) and the critical point (32.995° K) using a P-V-T cryostat. The smoothed data are found to agree with the results reported by Hoge and Arnold (1951) within the claimed accuracies. The data presented in this paper are believed to have an accuracy of ±0.003 atm, and can be used for computation of densities and thermodynamic functions. M.P.G.

N63-16745 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VIBRATIONAL-NONEQUILIBRIUM FLOW OF NITROGEN IN HYPERSONIC NOZZLES
Wayne D. Erickson Washington, NASA, June 1963 29 p 10 refs
(NASA TN-D-1810) OTS: $0.75

Quasi-one-dimensional calculations of the free-stream flow parameters in hypersonic nozzles for nitrogen with consideration of vibrational-nonequilibrium effects have been carried out. The results were obtained for stagnation temperatures from 1,000° K to 5,000° K, and are presented in the form of charts that may be used to estimate the vibrational-nonequilibrium effect of nitrogen in a hypersonic nozzle. The corresponding frozen-flow and equilibrium-flow results are also presented. Author

N63-16746 National Aeronautics and Space Administration, Washington, D.C.
EXPERIMENTAL AND THEORETICAL STUDIES ON THE FORMATION OF DETONATION WAVES IN VARIABLE GEOMETRY TUBES
Loren E. Bollinger, Michael C. Fong, James A. Laughrey, and Rudolph Edse (Ohio State U., Rocket Research Lab.) June 1963 81 p 17 refs
(NASA Grant NsG-44-60)
(NASA TN-D-1983) OTS: $2.25

Detonation induction distances were obtained experimentally for hydrogen–oxygen mixtures having fuel concentrations of 45, 66.67, and 75 percent hydrogen at initial pressures of 1 and 5 atmospheres in a detonation tube with variable internal geometry. When three stainless-steel rods of different diameters were located concentrically in the initiation region of a tube, the induction distances decreased as the diameter of the rods was increased. Increased turbulence and the generation of stronger pressure waves from the various geometrical configurations cause significant decrease in detonation induction distances in variable geometry tubes of the type investigated. When a combustion wave reaches an area discontinuity or a rod-insert, pressure waves are generated which strongly influence the transition process from deflagration to detonation. The mechanism of turbulence generation is quite important when obstacles are placed in the flow field. Author

N63-16787 Guggenheim Jet Propulsion Center, Calif. Inst. of Tech., Pasadena

SIMILARITY PARAMETERS FOR RADIATIVE ENERGY TRANSFER IN ISOTHERMAL AND NON-ISOTHERMAL GAS MIXTURES Technical Report No. 1

S. S. Penner, M. Thomas, and G. Adomeit Dec. 1962 47 p 10 refs (Grant AF-AFOSR-7163)

The similarity groups for multicomponent, reacting gas mixtures with radiative energy transport are derived. The resulting relations are used to consider the feasibility of scaling for flow processes with radiative energy transport under highly simplified conditions. The scaling parameters are derived for radiant-energy emission from isobaric and isothermal gases for arbitrary opacities and various spectral line and molecular-band models. Scaling parameters for radiant energy emission from isobaric but nonisothermal systems are discussed for arbitrary opacities and various spectral line and molecular-band models under the restrictions imposed on the allowed temperature profiles for dispersion and Doppler lines by the Eddington–Barbier approximation. The radiative scaling properties are considered for representative temperature profiles for both collision-broadened and Doppler-broadened line profiles on the basis of exact numerical calculations that have been performed for a rotational spectral line belonging to a molecular vibration-rotation band. It appears that simple scaling rules generally constitute a fair approximation for dispersion lines in nonisothermal systems but that corresponding relations apply to lines with Doppler contour only in the transparent gas regime. Author

N63-16813 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

AIRCRAFT AND ATMOSPHERIC TURBULENCE

J. K. Zbrozek *In its* Atmospheric Turbulence and its Relation to Aircraft. Proc. of a Symp. held at R.A.E., Farnborough, Nov. 16, 1961 1963 p 5–42 33 refs (See N63-16812 14-01) HMSO: £1 10s

The areas of aircraft engineering where atmospheric turbulence is of importance are reviewed, and the range of turbulence wavelengths of interest is indicated. The relationships of the discrete gust and spectral density methods of assessing aircraft behavior in atmospheric turbulence is briefly discussed. Examples of measured spectral densities of atmospheric turbulence are presented, and the areas where more information on atmospheric turbulence is needed are indicated. Author

N63-16814 Imperial Coll. of Science and Tech., London (Gt. Brit.)

THE INCIDENCE OF ATMOSPHERIC TURBULENCE

P. A. Sheppard *In* Royal Aircraft Establishment, Farnborough (Gt. Brit.) Atmospheric Turbulence and its Relation to Aircraft. Proc. of a Symp. held at R.A.E., Farnborough, Nov. 16, 1961 1963 p 43–57 (See N63-16812 14-01) HMSO: £1 10s

The incidence of atmospheric turbulence is related to the varying gross structure of the atmosphere. It is found that turbulence is a more or less sporadic atmospheric phenomenon resulting from one or a combination of several causes, such as heat transfer and water evaporation, atmospheric stratification, vertical winds, weather fronts, condensation of water vapor, convective storms, and boundary-layer turbulence. D.E.R

N63-16815 Manchester U. (Gt. Brit.)

THE MECHANISM OF ATMOSPHERIC TURBULENCE

T. H. Ellison *In* Royal Aircraft Establishment, Farnborough (Gt. Brit.) Atmospheric Turbulence and its Relation to Aircraft. Proc. of a Symp. held at R.A.E., Farnborough, Nov. 16, 1961 1963 p 59–87 39 refs (See N63-16812 14-01) HMSO: £1 10s

Atmospheric turbulence is found to be almost always accompanied by gradient temperatures and densities sufficient to modify the structure of the area. These gradients create buoyancy forces that can increase or decrease the turbulence; at the same time, they can create the equivalent of an incompressible fluid. The gradients are found to have two measurable quantities, one mean and one fluctuating. Further research is recommended to determine the final effects of density gradients on turbulence and to observe the scale and intensity in the free atmosphere. D.E.R.

N63-16816 Meteorological Office (Gt. Brit.)

THE STATISTICS OF TURBULENCE IN THE LOWER PART OF THE ATMOSPHERE

F. Pasquill *In* Royal Aircraft Establishment, Farnborough (Gt. Brit.) Atmospheric Turbulence and its Relation to Aircraft. Proc. of a Symp. held at R.A.E., Farnborough, Nov. 16, 1961 1963 p 89–109 25 refs (See N63-16812 14-01) HMSO: £1 10s

The statistical properties of turbulence in the atmosphere below 1000 m. and especially below 100 m., are summarized. The information has been accumulated in studying the transport and diffusion of atmospheric properties, and the effects of turbulence on structures. Included are: the form of the high-frequency section of the spectrum of turbulences, the scale of turbulences, the intensity of atmospheric turbulence, statistical variations in turbulence properties, and the equivalence of properties observed in space and time. D.E.R.

N63-16817 Meteorological Office (Gt. Brit.)

TURBULENCE IN THE STRATOSPHERE AND IN THE UPPER TROPOSPHERE

J. K. Bannon *In* Royal Aircraft Establishment, Farnborough (Gt. Brit.) Atmospheric Turbulence and its Relation to Aircraft. Proc. of a Symp. held at R.A.E., Farnborough, Nov. 16, 1961 1963 p 111–127 26 refs (See N63-16812 14-01) HMSO: £1 10s

The clear air turbulence in the upper troposphere that affects aircraft is investigated (primarily in temperature latitudes) and the following conclusions are drawn: (1) turbulence of significance to aircraft is mostly associated with the jet-streams of middle and high latitudes; (2) turbulence is most frequent and severe near the height of the maximum winds in the jet and decreases at levels above this height; (3) the severity and frequency of this turbulence may approach that encountered in thunderstorms but is usually much less; (4) the airflow over mountains accentuates and may cause turbulence at heights well into the stratosphere; (5) there are no preferred linear scales of eddies in the stratosphere, so there is no theoretical reason why certain eddies should occur more than others; and (6) clear air turbulence may be the breakdown of larger eddies which show up as mesoscale fluctuations of wind and temperature. D.E.R.

N63-16818 Imperial Coll. of Science and Tech., London (Gt. Brit.)

AIR FLOW IN CUMULONIMBUS

F. H. Ludlam *In* Royal Aircraft Establishment, Farnborough (Gt. Brit.) Atmospheric Turbulence and its Relation to Aircraft. Proc. of a Symp. held at R.A.E., Farnborough, Nov. 16, 1961 1963 p 129–146 11 refs (See N63-16812 14-01) HMSO: £1 10s

Cumulus clouds are thought to be formed of a succession of thermals, containing at any one time a few thermals with their characteristic circulations and thermal residues in which there are nonpersistent sinking motions. In cumulonimbus, the evaporation of precipitation can sustain deep strong downdraughts, and in considerable wind shear the organized circulation of the severe storm may develop, in which intense updraughts and downdraughts of comparable energy are side by side, persistent and quasi-steady. Maximum updraught speeds of 50 to 100 $msec^{-1}$ near the tropopause, and maximum cloud tops of 55,000 feet in

middle latitudes and 70,000 feet in lower latitudes must be anticipated. In the most intense updraughts of middle latitude storms, large hail may be encountered at all heights up to the tropopause level, and supercooled cloud-water concentrations corresponding to adiabatic ascent from the cloud base and some icing even above the −40° C level may be experienced. With radar, storm severity can be assessed from the height of echo tops in relation to tropopause level or from echo intensity. Author

N63-16819 Imperial Coll. of Science and Tech., London (Gt. Brit.)
STIRRING MOTIONS INDUCED IN STABLY-STRATIFIED AIRSTREAMS BY FLOW OVER MOUNTAINS
R. S. Scorer *In* Royal Aircraft Establishment, Farnborough (Gt. Brit.) Atmospheric Turbulence and its Relation to Aircraft. Proc. of a Symp. held at R.A.E., Farnborough, Nov. 16, 1961 1963 p 147–172 25 refs (See N63-16812 14-01) HMSO: £1 10s

Waves are characteristically smooth, but contain many different potentialities for the generation of stirring motions in clear air more violent than in approximately horizontal flow. Seven separate mechanisms are listed. Observations of clouds suggest that the billow flow pattern is the most common form of overturning. In jet streams, in sharp shear layers, and in layers of zero wind the more violent manifestations of overturning are most common. These observations are explained. Author

N63-16841 Aeronautical Research Associates of Princeton, Inc., N.J.
LINEARIZED PRESSURE DISTRIBUTIONS WITH STRONG SUPERSONIC ENTROPY LAYERS
W. D. Hayes (Princeton U.), R. D. Sullivan, and C. duP. Donaldson Jan. 1963 41 p 6 refs
(ARAP-44)

The pressure distribution which results from the disturbance of initially plane, parallel, and constant-pressure, inviscid, supersonic flow, in which there is a strong entropy variation near a surface, is investigated. The disturbance considered may arise from a small deflection of the surface or may be the result of a simple wave impinging on the entropy layer. The results obtained in this investigation are useful principally in that they permit the general behavior of such pressure distributions to be deduced without resort to the more general method of characteristics for rotational flows. Author

N63-16842 Boeing Scientific Research Labs. Mathematics Research Lab., Seattle, Wash.
ON AXIALLY SYMMETRIC WAVES IN LINEARIZED COMPRESSIBLE FLOW
J. W. Craggs Aug. 1962 70 p 7 refs
(Math. Note 273; DI-82-0205; AD-291445)

Considerable progress in the solution of two-dimensional, unsteady, wave problems has been made by the use of basic solutions with dynamic similarity, in which length and time are involved only in the combination (length ÷ time) with the dimensions of velocity. It is the purpose of this paper to show that this technique may be extended to cover problems in axially symmetric motion. The method of extension is described and is illustrated by reference to some problems in the motion of a compressible fluid, simplified by the use of acoustic approximation, in which density variations are assumed to be so small that the linearization of the equations of motion is possible. I.v.L.

N63-16881 Aeronautical Research Council (Gt. Brit.)
TABULATED SOLUTIONS OF THE EQUILIBRIUM GAS PROPERTIES BEHIND THE INCIDENT AND REFLECTED NORMAL SHOCK-WAVE IN A SHOCK-TUBE. I—NITROGEN. II—OXYGEN.
L. Bernstein London, HMSO, Apr. 1961 70 p 17 refs
(ARC-CP-626; supersedes ARC-22778) Available from HMSO: 9s 6d

Tabulated solutions are presented for the equilibrium gas properties behind the incident and reflected normal shock waves in the shock tube, for nitrogen and oxygen. They cover the range of shock-wave Mach numbers up to 12 at intervals of 0.2, for selected values of the undisturbed gas pressure between 1 and 2000 mm Hg. Author

N63-16892 Polytechnic Inst. of Brooklyn, N.Y.
A THEORETICAL AND EXPERIMENTAL ANALYSIS OF A NEW METHOD OF REDUCING AERODYNAMIC HEATING
Antonio Ferri, Victor Zakkay, and Paul A. Libby Mar. 1957 41 p 5 refs
(Contract AF 18(600)-694)
(PIBAL-325; AFOSR TN-57-113; AD-120466) (Declassified)

A method of reducing the aerodynamic heating problem is analyzed. The basic concept of this method involves reducing the stagnation pressure in a small layer of fluid close to the boundary layer; it can be applied to blunt and slender two- and three-dimensional bodies. Both the laminar and turbulent heat transfer are reduced. A simple mechanical design utilizing this concept and involving a shock generator ahead of the main body is proposed. The design considerations involved are discussed. Preliminary tests have been performed at a Mach number of 6.1 in the hypersonic facility of PIBAL. Primarily, turbulent heat-transfer measurements to slightly blunted cones have been made with shock generators consisting of circular rings. The results indicate considerable practicability of the method for hypersonic aircraft and missile design. Author

N63-16895 Aeronautical Research Council (Gt. Brit.)
NOTES ON SOME EXPERIMENTAL AND THEORETICAL RESULTS FOR THE BOUNDARY LAYER DEVELOPMENT AFT OF THE SHOCK IN A SHOCK TUBE
L. Bernstein (Ph. D. Thesis–London U., 1961) London, HMSO, 1963 41 p 18 refs
(ARC-CP-625; supersedes ARC-22753) Available from HMSO: 6s

A method of calculating the development of the boundary layer, laminar and turbulent, is presented in which the usual assumption of small disturbances due to boundary-layer growth is not made, and account is taken of the equation of mass continuity in the tube; the resulting momentum equation is integrated numerically. It is shown that a longitudinal pressure gradient is induced, and that the flow behind the shock wave accelerates as a result of the constrictive effect of the boundary layer, these effects being more marked for a turbulent boundary layer than for a laminar boundary layer. Author

N63-16903 Gt. Brit. Ministry of Aviation. Technical Information and Library Services, Mottingham
PHENOMENA AT THE BLADE TIPS OF KAPLAN TURBINES (UBER DIE VORGANGE AN DEN SCHAUFELENDEN VON KAPLAN-TURBINEN)
A. Betz Apr. 1963 13 p 2 refs Transl. into ENGLISH from Hydraulische Probleme, Berlin, VDI-Verlag, 1926 p 161–179
(TIL/T.5325)

This report considers the problem of energy loss by fluid flow through the space between rotor and stationary part of the turbine. Airfoil theory is not adequate for dealing with the secondary effects of flow which are considered here. Variables such as effective and real clearance widths are dealt with. Author

N63-16916 Naval Ordnance Lab., White Oak, Md.
THE STABILITY OF SELECTED BOUNDARY-LAYER PROFILES John O. Powers and Gerhard Heiche APPENDIX: DUNN-LIN FACTOR IN THE SECULAR EQUATION FOR LAMINAR STABILITY OF BOUNDARY LAYERS S. F. Shen
Apr. 1963 60 p 17 refs
(NOLTR 62-143; Aerodynamics Res. Rept.-186)

An investigation of the stability characteristics of infinitesimal disturbances in selected laminar boundary-layer profiles has been conducted. The results of the investigation give quantitative indications of the influence on boundary-layer stability of foreign gas injection, applied magnetic fields, and applied external shear. It is quantitatively shown that injected gases of large molecular weight and diameter may result in stabilization, whereas the light, small-diameter gases are generally destabilizing except for large values of the wall-to-free-stream temperature ratio. In addition, it is shown that a moderate external shear yields only percentage changes in the stability characteristics, whereas an applied magnetic field can produce order of magnitude changes in the stability. Author

N63-16923 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
TRANSIENT HEAT-TRANSFER MEASUREMENTS OF CATALYTIC RECOMBINATION IN A STEP-FUNCTION FLOW OF ATOMIC OXYGEN Interim Report
A. L. Myerson Aug. 1962 37 p 12 refs
(Contract AF 49(638)-782)
(CAL Rept. AF-1412-A-2; AFOSR-3203)

Heat-transfer measurements have been made by means of thin-film resistance thermometry which show, simultaneously, catalytic and noncatalytic transient heating. These transients are observed with millisecond resolution during a well-defined step-function of atomic-oxygen concentration in a subsonic flow. The differences are observable because of the short response time of the probe, and are thus in significant contrast with the behavior determined by the extant steady-state techniques. Differences in the behavior of the heat-transfer rate as a function of time are noted for conditioned and unconditioned surfaces. Author

N63-16926 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio
CALCULATION OF THE AXISYMMETRIC ISENTROPIC FLOW OF A REAL GAS
O. N. Katskova and A. N. Krayko 1962 17 p 4 refs Transl. from Zh. Vychislitel'noi Mat. i Matematicheskoi Fiz., v. 2, no. 1 1962 p 125–132
(FTD-TT-62-1057/1+2+4; AD 286579)

Axisymmetric supersonic nozzles are calculated. The work deals mainly with the experience accumulated in calculating isentropic flows of a real gas, using electronic computers. A number of calculation examples and a comparison with the flow of an ideal gas with a selected isentropic exponent are given. N.E.A.

N63-16928 Boeing Scientific Research Labs. Mathematics Research Lab., Seattle, Wash.
THE INFLUENCE OF VISCOSITY ON THE FLOW OF GASES THROUGH LONG TUBES AND SLOTS
F. Edward Ehlers May 1962 72 p 9 refs
(Math Note 257; D1-82-0168; AD-281877)

The isothermal, and the adiabatic flow of a viscous gas through a long straight channel were analyzed under the assumption of constant wall temperature, a Prandtl number of unity, and a parabolic boundary-layer velocity profile. Two regimes of flow were found. For inlet Mach numbers below a critical value, the boundary layer builds up and eventually fills the channel. The ratio of the length of this inlet region to the Reynolds number based on inlet conditions was found as a function of the inlet Mach number. The influence of this inlet region on the pressure distribution in a fully-developed viscous-channel flow is presented in the form of a length correction to the formulae of Grinnel for isothermal flow. For Mach numbers greater than the critical value, the boundary-layer thickness attains a maximum value without filling the entire cross section, and the flow in the center core then becomes choked. Graphs are given from which it is possible to estimate the mass flow through a long choked channel when the stagnation conditions of the flow and the geometry of the channel are known. N.E.A.

N63-16933 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio
THE FLOW OF DISSOCIATING NITROGEN BETWEEN TWO PARALLEL PLATES
L. A. Kulonen Aug. 28, 1962 15 p 10 refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekhan. i Astron., no. 1, 1962 p 116–123
(FTD-TT-62-1145/1+2+4; AD-286586)

The results of a solution to the problem of movement of dissociating nitrogen between two parallel plates are presented, and since air is 80% nitrogen, the results (flow characteristics) are used to give a qualitative idea of the flow of air under the same conditions. Conclusions are: (1) in all cases of the chemical state of the flow, where dissociation is taken into account, friction is higher than when dissociation is not considered; (2) the catalytic activity of the walls has a greater influence on friction, temperature distribution, and the degree of dissociation across the flow, than does the chemical state of the gas; (3) in the case of catalytic walls, the chemical state of the flow has almost no effect on friction, but the heat flow to the "cold" wall and the distribution of the dissociation across the flow depend on the chemical state, and finally, (4) diffusion thermal conductivity is important in determining friction and heat flow to the cold wall. D.E.R.

N63-16940 National Physical Lab. Aerodynamics Div., Teddington (Gt. Brit.)
A MASS FLOW PROBE FOR USE IN SHORT DURATION HYPERSONIC FLOWS
R. J. Stalker Mar. 21, 1962 17 p 1 ref Presented at The AGARD Fluid Dynamics Panel Specialists' Meeting on High Temperature Aspects of Hypersonic Flow, Brussels, Apr. 3–6, 1962
(NPL-AERO-1004)

A probe is described which measures mass flow per unit area in a hypersonic shock tunnel and therefore, in combination with the pitot pressure, provides a measurement of local velocity and density. Gas is entrained from a stream tube of known cross-sectional area, cooled to ambient temperature by passage through a bed of small glass spheres, and ejected through a choked orifice of known size. A measurement of pressure ahead of the orifice is then used to deduce the mass flow without reference to the high-temperature properties of the gas. Characteristics of the probe and experimental results are discussed. Author

N63-16943 Polytechnic Inst. of Brooklyn, N.Y.
AN EXPERIMENTAL INVESTIGATION OF THE REDUCTION OF AERODYNAMIC HEATING TO A 15° AND 20° BLUNTED CONE AT M_∞ = 6 AND 8
Victor Zakkay Feb. 1960 49 p 8 refs
(Contract AF 49(638)-445)
(PIBAL-469; AFOSR-TN-59-350; AD-306304) (Declassified)

Data for the laminar and turbulent heat transfer and pressure distribution on a 15° and 20° blunted cone, at a Mach number of 6 and 8, with several ring body configurations are presented. It is indicated that a larger reduction in the laminar heat transfer may be obtained as a result of increasing the Mach number. Effects of

shock-generator transition is investigated experimentally for a Mach number of 8° and a 15° blunted cone. It is indicated that the transition Reynolds number is affected by the presence of the shock generator. Author

N63-16948 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
VIBRATIONAL RELAXATION IN OXYGEN AT HIGH TEMPERATURES, I
N. A. Generalov Sept. 6, 1962 14 p 12 refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz. Astron. (Moscow), no. 2, Mar.–Apr. 1962 p 51–59
(TG-230-T330)

The method of measuring the vibrational relaxation time of oxygen molecules behind a shock front is described. The vibrational excitation time τ for O_2 varies from 2.5 to 0.17 μsec with change in temperature from 2500° to 10,000° K. The dependence of log τ on $T^{-1/3}$ agrees with the Landau-Teller theory. Author

N63-16955 Oak Ridge National Lab., Tenn.
ALPHA PARTICLE IONIZATION OF ARGON MIXTURES FURTHER STUDY OF THE ROLE OF EXCITED STATES
T. E. Bortner, G. S. Hurst, Mildred Edmundson (M. E. Thesis-Vanderbilt U.), and J. E. Parks May 23, 1963 59 p 13 refs
(Contract W-7405-eng-26)
(ORNL-3422) OTS: $1.50

This work is concerned with a study of the average energy required to form an ion pair, W, when alpha particles are absorbed in mixtures of argon with other gases. The other gases have been selected on the basis of their ionization potentials. One group consists of representative gases that have ionization potentials below that of argon (15.77 ev) and above the doublet metastable state of argon (11.49 and 11.66 ev). This list includes methane, carbon dioxide, nitrous oxide, xenon, and krypton. The other group of special interest consists of some gases with ionization potentials below the metastable state of argon. All gases tested in these two groups cause an increase in ionization, i.e., a decrease in W, when added to argon. As an illustration of this effect, the addition of 1/2% of acetylene to argon will increase the ionization by 23%. The experimental data, i.e., W as a function of relative concentration of the two gases, were fitted to a model in which it is assumed that energy is transferred from two excited levels in argon to the additive gases in collision processes. Good agreement between the experimental data and calculations based on the model is taken as additional evidence that the excited-state notion is correct. Author

N63-16969 Minnesota U. St. Anthony Falls Hydraulic Lab., Minneapolis
AN ACOUSTIC STUDY OF GASEOUS MICRO-BUBBLES IN BOUNDARY LAYERS AND PROPELLER WAKES Project Report [Jan. to Dec. 1962]
John F. Ripken and John M. Killen Dec. 1962 33 p 15 refs
(Contract Nonr-710(46))
(Rept. 67)

This report deals with exploratory tests to measure the nature of the free gas which occurs in natural water due to the dynamic disturbance of a ship. Acoustic attenuation measurements show that microgas bubbles are evolved from dissolved gases by the shear dynamics of a boundary layer, and that the rate of evolution increases as some function of the intensity and duration of the disturbance and of the pressure, viscosity, and gas content of the water. The tests were conducted in the laboratory, in large-scale simulations of a ship's boundary layer and propeller, and in wakes of actual ship propellers. Author

12 GEOPHYSICS

Includes: auroral phenomena; upper atmospheric studies; cartography; geodesy; and geomagnetism.

***For Van Allen belts see:* 28 Space Radiation.**

***For related information see:* 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.**

N63-16364 National Bureau of Standards. Central Radio Propagation Lab., Boulder, Colo.
TABLES OF MEDIANS OF IONOSPHERIC DATA—NOVEMBER 1956–SEPTEMBER 1962
Mar. 1963 26 p Abstracted from *its* CRPL-F(Part A)

One hundred tables of median ionospheric data are presented, representing data collected from November 1956 to September 1962, at different parts of the globe. D.E.R.

N63-16417 Georgia Inst. of Tech. Engineering Experiment Station, Atlanta
ALUMINA DISPERSAL AT 150 KM ALTITUDE—AN ANALYSIS OF THE PHOTOGRAPHIC RECORD Scientific Report No. 1
Louis C. Young Feb. 1963 57 p 12 refs
(Contract AF 19(604)-5467; ARPA Order 42; Proj. Defender)
(AFCRL-63-466)

Of the Project Firefly experiments sponsored by the Air Force Cambridge Research Laboratories in 1960, there was one which consisted of the release of finely powdered (0.2 micron) alumina dispersed by nitrogen at 149-km altitude in the sunlight before dawn: it was named Firefly Frances. Photographs taken by the Space Sciences Branch of Georgia Institute of Technology and by others have been measured and are analyzed in this report.

Author

N63-16458 Massachusetts Inst. of Tech., Cambridge
DIGITAL FILTERS AND APPLICATIONS TO SEISMIC DETECTION AND DISCRIMINATION Scientific Report No. 5
Jon F. Claerbout (M. S. Thesis) Feb. 1963 91 p 9 refs
(Contract AF 19(604)-7378; ARPA Order 180-61, Amend. 2)
(AFCRL-63-604)

The first part of this thesis is concerned with the mathematics of filtering in discrete time. Filters are defined for the purpose of (1) condensing waveforms into impulsive functions, (2) wave shaping, (3) noise suppression, (4) signal detection according to the criterion of maximum signal-to-noise output at an instant, and (5) the same over an interval. The behavior of the complex Fourier transforms of some of these filters is considered and connection is made with the theory of orthogonal polynomials. This leads to the possibility of a feed back representation of these filters. In the second part, computational experiments are described in which digital filters are applied to seismic body waves to (1) try to determine whether the first arrival is up or down on a seismogram corrupted with microseismic noise, (2) increase signal-to-noise ratio on seismograms where noise has almost obliterated signal, (3) assign polarity to each of two seismic first-motion wavelets so they can be termed "same" or "opposite," (4) remove spectrum of seismometer from data, and (5) investigate the time-varying spectral structure of underground nuclear-shot seismograms. Author

N63-16461 National Bureau of Standards. Central Radio Propagation Lab., Boulder, Colo.
MEAN ELECTRON DENSITY VARIATIONS OF THE QUIET IONOSPHERE NO. 9—NOVEMBER 1959
J. W. Wright, L. R. Wescott, and D. J. Brown Apr. 22, 1963 57 p 5 refs
(NBS-TN-40-9) GPO: $0.35

The CRPL has initiated a program for large-scale computation of electron-density profiles from ionospheric vertical soundings. Scaling is performed at field stations, permitting computation of hourly profiles. These profiles are combined to form hourly mean-quiet profiles for each station and month. The results of this program for the month of November are illustrated graphically.

Author

N63-16462 National Bureau of Standards. Central Radio Propagation Lab., Boulder, Colo.

MEAN ELECTRON DENSITY VARIATIONS OF THE QUIET IONOSPHERE NO. 10—DECEMBER 1959

J. W. Wright, L. R. Wescott, and D. J. Brown Mar. 24, 1963 57 p 5 refs

(NBS-TN-40-10) OTS: $0.35

The CRPL has initiated a program for large-scale computation of electron-density profiles from ionospheric vertical soundings. Scaling is performed at field stations, permitting computation of hourly profiles at the Central Laboratory. These profiles are combined to form hourly mean-quiet profiles for each station and month. The results of this program for the month of December are illustrated graphically.

Author

N63-16497 General Electric Co., Santa Barbara, Calif.

ATMOSPHERIC RADIATIVE TEMPERATURE

Roy A. Smith (M. S. Thesis - Calif. U., Los Angeles) Feb. 1963 87 p 34 refs

(SP-206)

The objective of this thesis is to determine the feasibility of making temperature measurements within the earth's atmosphere from a satellite well above the atmosphere. The work included is restricted to measurements in the microwave diatomic oxygen absorption band. Derived results show that temperature measurements accurate to a few percent are feasible using a radiometer with defined characteristics. Measurements of the thermal radiation within a bandwidth on the order of 50 kc centered in the neighborhood of 60 kmc are shown to be simply related to temperatures existing at determinable pressures between 125 and .2 millibar pressure altitude. Measurements down to pressures of about 10^{-3} millibars are found to be also possible but with reduced accuracy. Inference of temperature at altitudes between .2 millibar and 10^{-2} millibars requires more complex data manipulation than methods considered here.

Author

N63-16518 RAND Corp., Santa Monica, Calif.

PROPAGATION OF ACOUSTIC-GRAVITY WAVES FROM A SMALL SOURCE ABOVE THE GROUND IN AN ISOTHERMAL ATMOSPHERE

Allan D. Pierce May 1963 39 p 17 refs

(RM-3596)

This report discusses the effects of gravity and of the atmosphere's nonuniform density on sound propagation. It should be of interest to agencies and contractors concerned with the detection of nuclear explosions, and to other research workers who are studying low-frequency sound propagation in the atmosphere.

Author

N63-16585 Osservatorio Astrofisico di Arcetri, Florence (Italy)

SCINTILLATION OF THE RADIO-SUN AT CM WAVELENGTH Final Report

G. Noci, M. Piattelli, G. Righini, and G. Tagliaferri Mar. 31, 1963 52 p 13 refs

(Contract AF 61(052)-430)

(AFCRL-63-498)

A description is given of the radiometer and of the data-reduction system employed for correcting the observed fluxes from ground and sky radiation. The modal values of the amplitudes of the fluctuations show a marked difference at sunrise compared with sunset; the periods seem instead to be the same. Seasonal variations appear in the distribution of the fluctuations. A rough Fourier analysis shows the existence in the spectrum of at least two components. At large zenith distance, the extinction of the atmosphere and the reemission term have been deduced. Peculiarities of the scintillation during a total solar eclipse are reported.

Author

N63-16602 High Altitude Observatory, Boulder, Colo.

LIGHT SCATTERING BY PARTICLES IN THE UPPER ATMOSPHERE Technical Report

Gordon Newkirk, Jr. and John A. Eddy [1962] 108 p 125 refs Submitted for Publication

(Contract NONR-393(05))

During two flights of a balloon-borne coronagraph to a maximum altitude of 25 km (82,000 feet), observations of the wavelength distribution of skylight from 0.37μ to 0.79μ at a scattering angle of 2°.4 as well as the angular distribution at $\lambda = 0.44\mu$ from scattering angles 1°.7 to 58° were secured. The radiance of scattered light contributed by the coronagraph had been decreased to less than 10^{-8} times the radiance of the sun by means of an external occulting disk. The pointing gimbals developed for Stratoscope I centered the coronagraph on the sun to an accuracy of better than ± 1 minute of arc. Differentiation of the inferred concentrations per cm^2 column above a particular altitude with respect to height yields the local particle concentration at any altitude. A broad relative maximum in particle concentration or "dust layer" exists at 20 km (66,000 feet). The distribution of particle sizes at this altitude, as determined by the scattered skylight, compares favorably with the distributions determined by direct sampling. It is concluded that many of these particles are of stratospheric origin. The observations also demonstrate the existence of extremely thin laminae of scattering particles in the stratosphere. The data allow determination of the optical depth caused by large particles in the atmosphere. At 25 km, the optical depth for the nonmolecular component is approximately 2×10^{-4}.

Author

N63-16647 University of Southern Calif., Los Angeles

ON THE FREQUENCY OF OCCURRENCE OF THE AURORAL GREEN LINE (5577 A) IN PERSEID SPECTRA

John A. Russell *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors. held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 171–173 8 refs (See N63-16627 14-01) GPO: $2.75

A reexamination of seven Perseid spectra, obtained with the same instrument, has revealed five instances in which the auroral green line of O I at 5577 A is visible. All of the seven spectra were photographed during the showers of 1948–50, five of them within a 31-hour period. An inverse correlation appears to exist in these spectra between the strength of the auroral line and that of the H and K lines of ionized calcium. The points of appearance and disappearance of the auroral line relative to those of other lines were consistently similar. A consideration of several other meteor spectra indicated little if any correlation between the occurrence of the green line and general solar activity. There is, however, no evidence contrary to Halliday's findings that the green line appears only in the spectra of high-velocity meteors.

Author

N63-16657 Slovak Academy of Sciences. Astronomical Inst., Bratislava (Czechoslovakia)

THE DENSITY DISTRIBUTION OF TELESCOPIC METEORS AROUND THE EARTH'S ORBIT

L. Kresák and M. Kresáková *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 253–258 13 refs (See N63-16627 14-01) GPO: $2.75

The distribution of meteor orbits around the earth is analyzed on the basis of telescopic observations made at the Skalnaté Pleso Observatory from 1946 to 1959. This analysis includes the distribution of small meteors and faint telescopic meteors down to the 10th apparent magnitude. An estimation of the average probability for collision of the telescopic meteors with a spacecraft, is $10^{-6}m^{-2}day^{-1}$, where m equals the magnitude of the meteoritic particle. The meteoritic distribution is found to be characterized by a pronounced ecliptical concentration: two main maxima near the sun and antihelion point, and a secondary maximum at the apex. D.E.R.

N63-16672 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CHARGED PARTICLE REACTIONS OF IMPORTANCE IN THE IONOSPHERE
A. C. Aikin Aug. 1, 1962 18 p 16 refs
(NASA-X-615-62-132; NASA TM X-50029) OTS: $1.60 ph, $0.80 mf

Since the observed variations in ionic composition of the ionosphere cannot be fully explained by simple ion–electron recombination, other reactions which are considered to play a prominent role in the ionosphere are discussed. These include ion–neutral particle reactions, ion–atom interchange, charge exchange, negative ion reactions, and dissociative recombination. The discussion shows that further study of the systems involving O^+, O_2, N_2, and NO, especially in regard to determining the rate coefficients of their reactions, is necessary before a quantitative model of the ionosphere can be obtained. M.P.G.

N63-16675 California U., La Jolla. Scripps Inst. of Oceanography
THE ORIGIN OF BLACK SPHERULES FOUND IN PACIFIC ISLANDS, DEEP-SEA SEDIMENTS, AND ANTARCTIC ICE
Kurt Fredriksson and L. Robbin Martin Repr. from Geochim. Cosmochim. Acta, v. 27, 1963 p 245–248 10 refs
(NASA Grant NsG-98-60)
(NASA-CR-50028)

Black magnetic spherules from various sources have been analyzed with an electron microprobe. Some earlier work on cosmic spherules is discussed. Author

N63-16689 Minnesota U. School of Physics, Minneapolis
A STUDY OF THE PRECIPITATION OF ENERGETIC ELECTRONS FROM THE GEOMAGNETIC FIELD DURING MAGNETIC STORMS
K. A. Anderson (Calif. U.), J. R. Winckler, and P. D. Bhavsar Repr. from J. of Geophysical Res., v. 67, no. 10, Sept. 1962 p 3717–3736 11 refs Final version of this paper presented at the URSI Spring Meeting, Washington, Apr. 30–May 3, 1962
(NASA Contract NASw-56 - Related Rept.; Supported by NSF and ONR)
(CR-52)

The X-rays produced by electron precipitation from the geomagnetic field have been further studied by means of scintillation counters carried on balloons launched simultaneously at four sites between Waterloo, Iowa, and Flin Flon, Manitoba, Canada. The latitude and detailed time profile were measured during two magnetic storms on September 25, 1961, and October 1, 1961. The detailed comparison with the total energy stored in the magnetic field, obtained from recent measurements of the trapped radiation in the energy range comparable with the balloon measurements, shows that about one or two orders of magnitude more energy was precipitated than is normally stored quiescently, indicating that during the magnetic disturbance the addition of energy to the electrons in the magnetic field is necessary. A more extreme case, observed on July 16, 1961, at Fort Churchill and at Minneapolis, shows that during a strong magnetic sudden impulse more than two orders of magnitude more energy was precipitated than is quiescently trapped. The precipitation has been observed with the data averaged in time intervals between 120 sec and 0.1 sec. It is found that during periods of intense precipitation, a large fraction of the precipitation occurs in bursts of high intensity lasting only 0.1 sec. Power-spectrum-analysis methods have been applied to the counting-rate data, and it is shown that periodic precipitation occurs with periods of 0.8, 1.6, and 3.2 sec and higher multiples. It is suggested that this constitutes direct evidence for particle bunches near 60-Kev energy oscillating between conjugate points in the geomagnetic field. A Chree analysis applied with the large impulsive bursts as zero epoch confirms this picture and shows that the same periods occur in fixed phase relationship to the bursts. Author

N63-16718 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE GRAVITATIONAL POTENTIAL OF A TRIAXIAL EARTH
C. A. Wagner Oct. 31, 1962 30 p 9 refs
(NASA-MAR-4; NASA TM-X-50031; NASA-X-623-62-206) OTS: $2.60 ph, $1.10 mf

In most references, the spheroidal earth's exterior gravity potential is presented as a series of spherical harmonic terms. That series is derived in full detail as a classical solution of Laplace's equation in spherical coordinates. The series is truncated at the $1/r^3$ term as is often done in the literature. The physical significance of the harmonic coefficients as measured to date from gravity surveys and satellite data, developed according to the theory presented in this paper, gives: (1) an earth oblateness of 1/298.2 and (2) an equatorial eccentricity of 7.2×10^{-6}, which corresponds to a difference of major and minor equatorial diameters of about 300 feet. In addition to the harmonics contributing principally to the triaxial earth, the higher order harmonics are interpreted as being due to additional small mass deviations in longitude and latitude from the surface of this triaxial earth. Author

N63-16744 National Bureau of Standards, Boulder, Colo.
AN INTERPOLATION PROCEDURE FOR CALCULATING ATMOSPHERIC BAND ABSORPTIONS FROM LABORATORY DATA
LeAnn Droppleman, Lawrence R. Megill, and Robert F. Calfee June 3, 1963 23 p 6 refs
(NBS-TN-178) GPO: $0.20

A technique used for the calculation of absorption of the 4.3μ band of CO_2 has been extended to the 2.0μ, 2.7μ, and 15μ bands of CO_2. Results obtained agree favorably with the experimental data available. Author

N63-16779 General Dynamics Corp. John Jay Hopkins Lab. for Pure and Applied Science, San Diego, Calif.
RARE-EARTH, YTTRIUM, AND SCANDIUM ABUNDANCES IN METEORITIC AND TERRESTRIAL MATTER [Third] Quarterly Progress Report for the Period Ending May 15, 1963
R. A. Schmitt et al May 15, 1963 46 p 44 refs Submitted for Publication
(NASA Contract NASw-579)
(GA-4221; NASA-CR-50173) OTS: $4.60 ph, $1.58 mf

The abundances and selected isotopic ratios of the 14 rare-earth elements, yttrium, and scandium are determined by neutron-activation analysis in 13 meteorites and 2 terrestrial specimens: 3 carbonaceous, 2 hypersthenic, and 1 bronzitic (troilite phase) chondrite, 2 calcium-rich and 2 nakhlitic achondrites, 1 meso-siderite, 2 pallasites, an Australian eclogite, and a Columbia Plateau basalt. A proposed shell-model for a parent chondritic body is suggested that satisfies the abundances in all meteoritic phases, except type I carbonaceous and enstatic chondrites that are relegated to other parent meteoritic bodies. D.E.R.

N63-16829 Columbia U. Lamont Geological Observatory, Palisades, N.Y.
SEISMIC WAVES AND EARTH STRUCTURE IN THE CANADIAN SHIELD
James Brune and James Dorman. Repr. from Bull. Seismol. Soc. Am., v. 53, no. 1, Jan. 1963 p 167-210 45 refs
(Contract AF 19(604)-7376)
(AFCRL-63-294)

Careful measurements of phase velocities in the Canadian shield have been made in the period range 3 to 90 sec for Rayleigh waves, and 12 to 60 sec for Love waves by phase correlation of wave trains. The phase and group velocities are higher than any found in any other continental area, indicating relatively higher shear velocities in the crust and upper mantle. A theoretical layered model of the crust and upper mantle consistent with the various types of data has been derived by an inversion method employing least-squares curve-fitting of phase-velocity data. Higher mode phase-velocity dispersion curves computed from the theoretical model are used for computing theoretical seismograms for the Canadian shield. Author

N63-16848 Air Force Systems Command. Foreign Technology Div., Wright-Patterson AFB, Ohio
TAKING INTO ACCOUNT THE INFLUENCE OF THE COHERENTLY REFLECTED PORTION OF A SIGNAL UPON ITS CORRELATION CHARACTERISTICS
V. A. Chena. Sept. 4, 1962 14 p 8 refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz., Tomsk (USSR), v. 4, 1961 p 17-22
(FTD-TT-62-1029/1+2+4; AD-286571)

A correlation function is obtained for the squared envelope of a signal reflected from the ionosphere, which takes into account the coherently reflected and the scattered signal simultaneously. The relation of the correlation functions to the input and output of a receiver of signals reflected from the atmosphere with different values of the turbidity function is analyzed. It is shown that the value of the negative oscillations of the correlation function of the squared envelope for a rough screen with drift depends upon the value of the turbidity function. Author

N63-16921 Texas U. Electrical Engineering Research Lab., Austin
WIND AND TEMPERATURE IN THE ATMOSPHERE BETWEEN 30 AND 80 KM. Tenth Quarterly Technical Report, Oct. 1-Dec. 31, 1962
N. K. Wagner and D. R. Haragan [1962] 27 p 11 refs
(Contract DA-23-072-ORD-1564)

The problem of heat conduction along the lead wires to the thermistor in a rocketsonde is analyzed, and wind and temperature measurement made in the stratosphere above Ft. Greely, Alaska, are compared with those made previously at midlatitude stations. The thermistor heat balance studies indicate that the effects of lead conduction should be considered above approximately 55 km. The outstanding features of the mean temperature profile at Fort Greely in the fall of 1961 is the upward extension of the lower stratosphere (the region which is approximately isothermal) as compared to the temperature conditions at midlatitudes during the same season. The wind measurements which were made simultaneously with the temperature measurements at Ft. Greely are being analyzed in order to correlate wind and temperature fields. The observational data are being correlated on an individual station basis, rather than by synoptic correlation, because useful results can be obtained from evaluating the smaller scale features which contribute to energy and momentum exchange in the stratosphere. M.P.G.

N63-16952 Weston Observatory, Mass.
RESEARCH DIRECTED TOWARD THE STUDY OF RAPID FLUCTUATIONS OF THE GEOMAGNETIC FIELD. Final Report
Daniel Linehan. Oct. 31, 1962 60 p 2 refs
(Contract AF 19(628)-211)
(AFCRL-63-436)

An investigation was made of the characteristics and origins of the natural magnetic-field fluctuations in the frequency range of approximately 0.01 to 50 cps, with particular emphasis on frequencies from about 0.1 to 3 cps. Field records were made of the fluctuations. A discussion is presented of the hardware phase of the installation of the measurement facilities at Strawberry Hill Field site, Concord, Massachusetts. A description of the instrumentation is given, and early measurements are included. Author

N63-16954 National Bureau of Standards, Boulder, Colo.
THE TOTAL ELECTRON CONTENT OF THE IONOSPHERE AT MIDDLE LATITUDES NEAR THE PEAK OF THE SOLAR CYCLE
O. K. Garriott and S. C. Hall (Stanford U.), and R. S. Lawrence, and D. Jane Posakony. Repr. from J. Geophys. Research, v. 68, no. 7, Apr. 1, 1963 p 1889-1898 19 refs
(NASA Order NTF-83; NASA Grant NsG-30-60)

The electron content of the ionosphere during the period September 1958 to December 1959 has been calculated from observations of the Faraday rotation of the signals from Sputnik 3 recorded at Boulder and Stanford. Diurnal and seasonal effects are pronounced, and from these measurements are deduced daytime temperatures of 1500° K in winter and nearly 2000° K in summer, with a diurnal variation of at least 330° K and very likely as much as 500° K. During magnetic storms, a reduction in total electron content and an increase in scale height are found to accompany the usual decrease in maximum electron density. Author

N63-16961 Geological Survey, Washington, D.C.
AERORADIOACTIVITY SURVEY AND AREAL GEOLOGY OF THE GEORGIA NUCLEAR LABORATORY AREA, NORTHERN GEORGIA (ARMS-1)
Jules A. Mac Kallor. Washington, AEC Div. of Biology and Medicine, Apr. 30, 1963 34 p 30 refs
(CEX-58.4.8) OTS: $1.25

An airborne gamma-radioactivity survey of about 7000 square miles around the Georgia Nuclear Laboratory (GNL) in Dawson County, Ga., was made. Radioactivity contacts shown on a 1:250,000 map delineate areas of similar radioactivity, which, in general, trend northeast, parallel to the geologic strike. Many, but not all, formations correlate closely with radioactivity units. Changes of radioactivity within some formations may indicate facies changes. Within the Valley and Ridge province, bedrock consists of sedimentary rocks of Paleozoic age; the radioactivity is from 300 to 900 counts per second (cps). Areas of limestone and dolomite are characterized by radioactivity lows, usually less than 500 cps. Most areas of shale have a radioactivity of 600 to 900 cps. Bedrock in the Piedmont consists mainly of igneous and metamorphic rocks of Precambrian and Paleozoic ages, and the radioactivity ranges from about 250 to 2000 cps. The least radioactive rocks (250 to 500 cps) are hornblende gneiss, dioritic injection gneiss, and some of the granitic gneiss. The most radioactive rock is the

augen gneiss in Bartow and Cherokee Counties (1000 to 2000 cps). Some of the granitic gneiss, biotite gneiss and schist, and the Talladega Slate have a radioactivity of slightly more than 1000 cps. Composite samples of surficial material were collected from sites directly under the flight path of the aircraft. The equivalent uranium was plotted against cps obtained from the aerial surveying. From 600 cps, which corresponds to slightly more than 0.001 percent equivalent uranium, to 1600 cps, each 200-cps increase corresponds to an increase of almost 0.001 percent equivalent uranium. Author

13 HEAT TRANSFER

Includes: ablation; cooling; heating; and other thermal effects.

For aerothermodynamics see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings and Control Surfaces.

For combustion see: 26 Propellants and Combustion.

For related information see: 11 Fluid Mechanics.

N63-16483 Argonne National Lab., Ill.

NUCLEATE BOILING CHARACTERISTICS AND THE CRITICAL HEAT FLUX OCCURRENCE IN SUBCOOLED AXIAL-FLOW WATER SYSTEMS

R. J. Weatherhead Mar. 1963 34 p 16 refs

(Contract W-31-109-eng-38)

(ANL-6675)

An empirical analysis is used to equate the pressure term in the Jens–Lottes nucleate boiling wall superheat equation to the liquid coolant surface tension, which modifies the equation to

$$T_w - T_f = 0.18 \times 10^6 \sigma (Q''/10^6)^{1/4}$$

for surfaces of "average" nucleation capability. This equation is used to determine the pressure dependency of several nucleate boiling characteristics, including proportionate nucleate bubble sizes. The pressure dependency of the nucleate bubble-size characteristic is shown to be virtually identical with the pressure dependency of the mass-velocity term in the Jens–Lottes subcooled water critical heat-flux correlation. Other alterations and additions are explained, and the modified form of the equation is compared with data for circular and rectangular flow channels. Several subcooled boiling-flow regimes are hypothesized and explained to account for the unusual effect of the mass velocity upon the critical heat flux in the low-subcooling, low-steam-quality region. A pronounced surface effect, paralleling the nucleate boiling surface effect, upon the critical heat-flux occurrence at the higher subcoolings is illustrated, and used to explain apparent discrepancies within and among several representative bodies of critical heat-flux data. Author

N63-16487 California U., Berkeley. Inst. of Engineering Research

SUPERSONIC STAGNATION POINT HEAT TRANSFER TO HEMISPHERE CYLINDERS AT LOW REYNOLDS NUMBERS

H. Tong and W. H. Giedt Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Feb. 1963 56 p 18 refs

(Contract AF 33(657)-8607)

(ARL-63-25)

Stagnation-point heat transfer at low Reynolds numbers in a supersonic airstream was investigated experimentally. A transient technique was employed using precooled thin-walled hemisphere-cylinder models. Tests were conducted at nominal Mach numbers of 2, 4, and 6, and in the Reynolds number range of 80 to 1500. Results are best represented by continuum boundary-layer theory. Scatter was about ±10 percent, so that any possible small shock-wave-vorticity effect at the lower values of Reynolds number could not be identified. Author

N63-16525 Avco Corp. Research and Advanced Development Div., Wilmington, Mass.

TRANSPORT PROPERTIES OF NITROGEN, HYDROGEN, OXYGEN, AND AIR TO 30,000°K Technical Memorandum

Jerrold M. Yos Mar. 22, 1963 70 p 69 refs

(Contract AF 33(616)-7578)

(RAD-TM-63-7)

The viscosity, thermal conductivity, electrical conductivity, binary diffusion coefficients, and total radiated power in the continuum have been calculated for hydrogen, nitrogen, oxygen, and air for temperatures from 1000° to 30,000° K and for pressures from 1 to 30 atm. The viscosity, electrical and thermal conductivities, and diffusion coefficients were calculated from the first Chapman–Enskog approximation, using the best available cross-section data from the literature. Coulomb collisions were treated approximately by means of effective collision cross sections, chosen to make the calculated transport properties agree with the results of Spitzer and Härm for the fully ionized case. Effects of ambipolar diffusion and charge exchange were included in the calculation. The continuum radiated power was calculated from Kramers' semiclassical approximation, with an empirical correction factor to make the results agree with the limited experimental data available in the range of interest. Author

N63-16536 Avco-Everett Research Lab., Everett, Mass.

THEORY OF STAGNATION-POINT HEAT TRANSFER IN A PARTIALLY IONIZED DIATOMIC GAS

James A. Fay and Nelson H. Kemp Apr. 1963 66 p 23 refs

(Contract AF 04(694)-33)

(Avco-Everett Res. Rept.-144; BSD-TDR-62-347)

Stagnation-point heat transfer in a partially ionized diatomic gas is considered. The concept of frozen thermal conductivity is used, and a simplified "binary diffusion" model of the gas is proposed. In this model, the charge-exchange cross section for atom–ion collisions is taken to be infinite so there is no relative diffusion of the atoms and the ion-electron pairs. This permits the diffusion effects to be dealt with as if there were only two components—molecules and atom–ion–electron particles—and thus greatly simplifies the calculations. However, the thermodynamic and transport properties are evaluated using all four components—molecules, atoms, ions, and electrons. With this model, calculations are made for both frozen and equilibrium boundary layers in nitrogen up to about 60,000 ft/sec, and arguments are presented for applying the results to air. The results show the equilibrium heat-transfer rate to be progressively smaller than the frozen rate as the velocity increases above 30,000 ft/sec, the ratio reaching 2/3 at 50,000 ft/sec. Simple correlation formulas for the results are given. Author

N63-16550 Columbia U. School of Engineering and Applied Science, New York, N.Y.

AN EXPERIMENTAL STUDY OF HEAT TRANSFER AT HIGH TEMPERATURE DIFFERENCES IN TURBULENT AIR FLOW BETWEEN A ROTATING CYLINDER AND A STATIONARY CONCENTRIC OUTER CYLINDER Final Report

G. S. Longobardo and H. G. Elrod Aug. 1962 340 p refs

(Contract AF 49(638)-1001)

(AFOSR-3207)

A study has been made of convective heat transfer between a rotating cylinder and a stationary, concentric outer cylinder and a stationary, concentric outer cylinder for the Taylor number

range 2000 to 9000, and for rotor surface temperatures in the range 80° F to 430° F. Measurements were made of overall heat transfer, and velocity and temperature distributions in the gap between the two cylinders. A hot-wire anemometer was used to determine whether secondary flows exist in the gap in the Taylor number range of the investigation. Author

N63-16688 · National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EXPERIMENTAL INVESTIGATION OF ROCKET-ENGINE ABLATIVE-MATERIAL PERFORMANCE AFTER POSTRUN COOLING AT ALTITUDE PRESSURES
R. James Rollbuhler Washington, NASA, June 1963 29 p 6 refs
(NASA TN D-1726) OTS: $0.75

A rocket-engine nozzle made of ablative material was tested as part of a hydrogen–oxygen rocket engine, which fired repeatedly in a vacuum environment. After each run, the nozzle cooled at low pressure. Its ablative behavior in subsequent runs did not differ appreciably from that of an identical ablative nozzle tested under similar conditions, but cooled at 1-atmosphere pressure. Author

N63-16792 Michigan State U., East Lansing
THERMAL CONDUCTIVITY OF DILUTE COPPER ALLOYS
M. Garber, B. W. Scott (Ph. D. Thesis - 1962), and F. J. Blatt [1962] 22 p 21 refs
(Supported by Army Research Office and NSF)
(AROD-1954-10)

Lattice thermal conductivities between 10° K and 90° K of three copper-tin and five dilute ternary copper-base alloys are deduced from measurements of the total thermal conductivity and residual resistivity. The reduction in the lattice thermal conductivity above 40° K is in fair agreement with theoretical estimates which assume that the major effect of solutes on lattice thermal conductivity is through anisobaric phonon scattering. Below 20° K, the lattice thermal conductivity is diminished in relation to the residual electrical resistivity, in agreement with a theory due to Pippard and elaborated by Lindenfeld and Pennebaker. Author

N63-16890 Polytechnic Inst. of Brooklyn, N.Y.
A METHOD OF REDUCING THE HEAT TRANSFER TO ANNULAR SHOCK GENERATORS
Gennaro Aiello and Victor Zakkay Jan. 1961 27 p 9 refs
(Contract AF 49(638)-445)
(PIBAL-612; AFOSR-59) (Declassified)

The heat transfer and pressure distributions on two rings were determined at a Mach number of 7.9 at the PIBAL hypersonic facility. The maximum values of heat transfer and the location of the stagnation point are compared to those obtained in previous tests at PIBAL, on rings with other values of outer-to-inner-diameter ratio. The heat-transfer distributions were compared to those predicted by existing laminar hypersonic theory. The maximum value of heat transfer decreases as the ratio of outer-to-inner diameter increases, providing a basis for choosing a practical configuration for the use of rings as shock generators. It is also indicated that the heat-transfer distribution is not affected by the addition of a cylindrical section to the ring. Furthermore, it is seen that the two-dimensional and axisymmetric heat-transfer distributions, when nondimensionalized with respect to the stagnation-point value, are approximately the same. Author

N63-16891 Polytechnic Inst. of Brooklyn, N.Y.
INVESTIGATION OF THE HEAT TRANSFER AND PRESSURE DISTRIBUTION FOR TWO SHOCK GENERATORS Victor Zakkay and Robert J. Gresci **APPENDIX A. DEPENDENCE OF MAXIUM RING SURFACE TEMPERATURE OF REENTRY TRAJECTORY** Melvin Epstein
Mar. 1958 56 p 10 refs
(Contract AF 18(600)-694)
(PIBAL-437; AFOSR TN-58-255; AD-154159) (Declassified)

Tests have been performed at a Mach number of 6.0 in the hypersonic facility of the Polytechnic Institute of Brooklyn Aerodynamics Laboratory to determine the heat transfer and pressure distributions on two annular bodies of revolution, which can be utilized as shock generators. Measurements of static and stagnation pressures were made in the wake of one body; from the results, the Mach-number distributions at three different axial positions behind the model were also determined. The pressure distribution and heat transfer over both models were measured, and compared with the existing laminar hypersonic theories modified according to the more exact stagnation-point theory. In an appendix, there is presented for various entrance velocities an investigation of the size of the shock generator required to limit the maximum temperature at its surface for a straight-line reentry trajectory. Author

N63-16924 Naval Ordnance Lab., White Oak, Md.
HEAT TRANSFER TO THE THROAT REGION OF A SOLID PROPELLANT ROCKET NOZZLE
Roland E. Lee Feb. 26, 1963 36 p 11 refs
(NOLTR-62-72; Aerodynamics Res. Rept.-178)

A combined experimental and analytical method for obtaining the surface heat-transfer rate in a rocket nozzle has been developed. This method is particularly applicable to high-energy rocket-nozzle flow where instrumentation directly on the flow surface is impractical. The method employs data of the temperature-versus-time history of two points within the nozzle wall, with one of them near the surface of the nozzle. The temperature distribution between the two points and the temperature of the nearby nozzle surface are computed on the IBM 7090, using the implicit numerical solution to the one-dimensional transient-heat-conduction equation. The heat-transfer rate at the nozzle surface is then calculated from the computed temperature gradient at the surface. Application of this method to determine the heat-transfer rate at the throat of a molybdenum insert in a conical solid-propellant rocket nozzle is presented. The nozzle was operated at nominal chamber conditions of 1150 psia and 2500° K in the Johns Hopkins University Applied Physics Laboratory rocket-tunnel facility. The experimental technique is described. The experimental data are compared with theoretical predictions and other available experimental results. Good agreement is obtained with turbulent heat-transfer rates computed from the numerical integration of the boundary-layer momentum equation. Author

N63-16957 Minnesota U. Inst. of Tech., Minneapolis
AERODYNAMIC AND HEAT TRANSFER STUDIES WITH EVAPORATIVE FILM COOLING AT HYPERSONIC MACH NUMBERS [Final Report]
Rudolph Hermann and W. L. Melnik Sept. 1962 105 p 46 refs
(Contract AF 49(638)-190)
(RAL-RR-189)

Evaporative film cooling experiments were conducted on hemisphere-cylinders blunted cones, and flat-faced cylinders at Mach 6.8 in a high-temperature, hypersonic blowdown wind tunnel. The heat transfer from a high-speed, high-temperature airstream was determined when the body surfaces were coated with an evaporating liquid film. Insulation characteristics of evaporative film coating were established through determination of the flow-field properties and aerodynamic heat transfer in the absence of mass transfer under identical freestream conditions. Boundary-layer flow was also evaluated along with the bow shock shape and shock detachment distance. C.L.W.

N63-16975 General Electric Co. Space Sciences Lab., Philadelphia, Pa.
RESPONSE OF CHARRING ABLATORS TO HYPERTHERMAL ENVIRONMENT
R. D. Mathieu Feb. 1963 38 p 21 refs
(Contract AF 04(647)-617)
(R63SD20)

A study is made of the thermal response of charring ablators to given environmental conditions. The heat-protective materials considered form gases and a porous char as they undergo thermal degradation in depth. The analysis considers the transient conditions and the effect of the surface pressure on the gas pressure buildup within the porous char. The effects of porosity and permeability are included. Results of the temperature, material density, and gas-pressure distribution through the heat-protective layer are presented for a typical charring material. Two cases are considered: in the first case, the material undergoes one degradation reaction; in the second case, the material undergoes two successive reactions. The inclusion of char removal can also be accomplished by this study. Author

N63-16979 Northwestern U., Evanston, Illinois
HEAT TRANSFER IN THE CRITICAL REGION Final Report
Rodney D. Wood (Nebraska U.), J. M. Smith (Calif. U.), and J. C. Slattery Apr. 1963 39 p
(Contract DA-11-022-ORD-2674)
(AROD-2000-7)

Unusual heat-transfer phenomena have been observed between solid surfaces and fluids near their thermodynamic critical point. To better understand these phenomena, temperature and velocity profiles and local heat-transfer coefficients were measured for turbulent flow of carbon dioxide in a tube at 1075 psia (p_c = 1071 psia). The results indicate (1) a severe flattening of the radial temperature profiles, (2) a maximum in the velocity profile between the wall and the tube axis, and (3) a maximum in h', when the bulk fluid temperature passes through the transposed critical temperature. Author

14 HUMAN BEHAVIOR

Includes: crew training and evaluation; piloting; psychological factors.

For simulators see: 10 Facilities.
For related information see: 16 Life Sciences.

N63-16377 George Washington U. Human Resources Research Office, Washington, D.C.
VIGILANCE PERFORMANCE AS A FUNCTION OF TASK AND ENVIRONMENTAL VARIABLES
Bruce O. Bergum and Donald J. Lehr Ft. Bliss, Tex., Army Air Defense Human Research Unit, May 1963 37 p 7 refs
(Contract DA-44-188-ARO-2)
(HumRRO-RR-11)

Experiments were conducted to compare the effects on vigilance of paired monitoring, high and low signal rates, rest periods, knowledge of pretest performance and of monitoring scores, rewards, supervision, and false signals. A final study compared four combinations of the three most effective variables—multiple monitoring, rest periods, and supervision. The results suggest that significantly high levels of performance can be maintained over fairly extended time periods, with careful selection of conditions. Author

N63-16472 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th). Wright-Patterson AFB, Ohio
PHYSIOLOGICAL AND MECHANICAL RESPONSE OF THE HUMAN TO LONGITUDINAL WHOLE-BODY VIBRATION AS DETERMINED BY SUBJECTIVE RESPONSE Final Report
Edward B. Magid, Rolf R. Coermann, Richard D. Lowry, and William J. Bosley June 1962 17 p 3 refs
(MRL-TDR-62-66) OTS: $0.50

Subjective response was investigated in order to gain an insight into the mechanical properties of the body. Fifteen subjects experienced with whole-body vibrations were included in a two-phase study, in an attempt to measure qualitatively and quantitatively subjective response to longitudinal vibrations from 1 to 20 cps in a sitting position. In the first phase, the complexity of body response to whole-body vibration was demonstrated since the subjects usually experienced several symptoms for each frequency tested. The second phase suggested that the sensations were resonance dependent. Mechanical and physiological responses were correlated. Author

N63-16695 Martin Co. Space Systems Div., Baltimore, Md.
HUMAN VIBRATION AND IMPACT ISOLATION WITH A FULL LENGTH AIRBAG RESTRAINT SYSTEM
Bruce Cooper, Carl Blechschmidt, Keith Mc Closkey and Carl Clark Mar. 1963 50 p 10 refs
(RM-146)

The system employed full-length latex airbags to support the subject both in the front and back. The bags were inflated within a box container (22 × 34 × 84 inches) at pressures up to ten inches of water. Ninety-five experimental vibration tests were run with varying bag pressures within a vibration spectrum of 5 to 2000 cps, with an input G_x force of approximately 1 $\pm$4 G_x. Input displacement (double amplitude) varied from 0.5 to 0.000019 inch. G_x forces imparted to the subject's head and hip areas, and head displacement were measured, as well as response times to command signals, including an abort light, and horizontal meter and vertical meter changes. The airbag-restraint-system impact study has indicated the significant impact attenuation potential of this type of controlled restraint system. Author

N63-16715 Courtney and Co., Philadelphia, Pa.
THE PILOT'S VISUAL TASK: A STUDY OF VISUAL DISPLAY REQUIREMENTS
Mark G. Pfeiffer, W. Crawford Clark, and James W. Danaher Mar. 1963 126 p 33 refs
(Contract N61339-783)
(NAVTRADEVCEN 783-1)

An analysis was made of the perceptual characteristics of the pilot's visual world while performing various flight tasks. These were compared with the perceptual characteristics made available by typical nonprogramed visual displays attached to flight trainers. An experiment was then conducted in the F-100 simulator equipped with the 151 visual attachment to determine training effects. It was determined that, even among experienced subjects, performance significantly improved, both with regard to (1) the detection of inflight emergencies and (2) the maintenance of aerodynamic stability. Recommendations are made for improvements in external visual displays to enhance the training value of flight simulators. Author

15 INSTRUMENTATION

Includes: design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; and sensors and transducers.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N63-16344 Watkins-Johnson Co., Palo Alto, Calif.
APPLIED RESEARCH ON TECHNIQUES FOR LIGHT MODULATION DETECTION Interim Engineering Report No. 3, 1 Jan. through 31 Mar. 1963
S. E. Sobottka [1963] 18 p 2 refs
(Contract AF 33(657)-8996)
(W-J 63-610R12)

Techniques have been developed for constructing a convergent gun traveling-wave phototube. The procedure for transferring the photocathode from the fabrication vessel to the tube body has been tested and found successful. This transfer technique greatly simplifies the construction of the phototube by eliminating the need for cathode fabrication and positioning assemblies inside the photocathode. The light-modulator design and construction has been completed and tested. With 1.3 watts of input RF power at 3420 mc/sec, the modulation index is 0.1. This modulator, together with a superpressure Hg arc light source, will be used to determine the RF characteristics of the phototubes during the next period. Author

N63-16373 Douglas Aircraft Co., Inc. Aircraft Div., Long Beach, Calif.
ARMY-NAVY INSTRUMENTATION PROGRAM (ANIP). FIXED WING RESEARCH PHASE [Final] Technical Summary Report
(Contract Nonr-1076(00))
(Rept. 44241; Supplement to ANIP Hist. Rept. 40641A)

This report summarizes the significant technical achievements of the Army-Navy Instrumentation Program and provides a bibliography of technical reports on technical subjects. The following areas are treated in the report: (1) human factor, (2) system analysis, (3) display media, (4) data processing, (5) sensors, (6) materials and techniques, and (7) simulation and test. N.E.A.

N63-16378 Rochester U., N.Y.
SEVERAL TYPES OF SPARK COUNTERS USING THE SONIC SPARK LOCATION PRINCIPLE
H. W. Fulbright, J. A. Robbins, and A. K. Hamann Apr. 15, 1963 48 p 4 refs
(Contract AT(30-1)-875)
(NYO-10261)

This report discusses some examples of special spark counters applicable to nuclear structure experiments. They are: (1) an essentially one-dimensional counter, for use, for example, at the focal plane of a magnetic spectrometer; (2) a composite counter for fast neutron spectrometry consisting of two scintillation counters and a disc-shape spark counter; (3) an angular distribution apparatus in which the angular position of a charged particle emerging from a nuclear reaction is determined by use of a curved spark counter; (4) a gamma ray pair spectrometer of the semi-circular focusing type with two one-dimensional spark counters; and (5) an angular correlation apparatus in which at least one charged particle is involved, its angle of emission being determined by sonic spark location. N.E.A.

N63-16418 General Dynamics Corp. John Jay Hopkins Lab. for Pure and Applied Science, San Diego, Calif.
40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR Quarterly Progress Report for the Period Ending, Sept. 30, 1962
Washington, AEC Div. of Technical Information, Apr. 15, 1963 55 p 1 ref
(Contract AT(04-3)-314)
(GA-3676) OTS: $1.25

Progress is reported in the following areas: (1) development of materials for the reactor core; (2) development of the reactor core and reflector; (3) development of control-rod drives and fuel-handling equipment; (4) development of plant auxiliary systems; (5) analysis of plant hazards. I.v.L.

N63-16426 National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
EXPLORER XII SATELLITE INSTRUMENTATION FOR THE STUDY OF THE ENERGY SPECTRUM OF COSMIC RAYS
U. D. Desai, R. L. Van Allen, and G. Porreca Washington, NASA, May 1963 19 p 3 refs
(NASA TN D-1698) OTS: $0.50

This report describes the signal conditioning and programing processes required to digitize, store, and read-out the data from the various detectors used in cosmic-ray instrumentation aboard the Energetic Particles Satellite, Explorer XII. Excitation of the sensors by particles produced signals which were subcommutated in a multiplexing system separate from the one used in the satellite telemetry system. Two storage systems (15- and 512-bit capacities) and the programing method used to process the data from three separate detectors are described. Author

N63-16453 Union Carbide Nuclear Co., Oak Ridge, Tenn.
AN AUTOMATIC MASS SPECTROMETER FOR RELATIVE MEASUREMENTS OF URANIUM ISOTOPES
A. Langdon and H. A. Kermicle May 20, 1963 19 p 5 refs
(Contract W-7405-eng-26)
(K-1444) OTS: $0.50

A mass spectrometer has been developed for making automatic relative measurements of uranium isotopes. This report describes the major features which enable the analyst to operate several spectrometers of this type concurrently. The instrument is programed to make a determination in 13.5 minutes, and a digital ratiometer and printer in the measuring system provide printed data output. The cost of making ratio-of-ratios determinations has been reduced over 40 percent, the variance of a determination has been lowered significantly (by a factor of 2.5 for the measurements usually made), and the cost of maintaining the automatic spectrometers is 30 percent less. Author

N63-16460 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
AN EVAPORATING FILM CALORIMETRIC ENTHALPY PROBE [Final Report, Nov. 1961-Dec. 1962]
F. C. Haas Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Feb. 1963 92 p 127 refs
(Contract AF 33(657)-7774)
(ARL-63-47)

A calorimetric enthalpy probe of small size, capable of continuous operation in a high-temperature, high-heat-flux environment, such as an arc, is described. The instrument operates by removing a sample from a hot-gas stream and cooling it by evaporative film cooling until the temperature of the gas sample is low enough for measurement by conventional means. The composition of the cooled gas sample is measured and the total enthalpy of the hot gas entering the instrument is determined by an energy-balance technique. The structure of the instrument may be maintained at a tolerable temperature level by forced convective cooling or by evaporative film cooling. Author

N63-16464 Block Associates Inc., Cambridge, Mass.
RESEARCH AND DEVELOPMENT OF NEW TECHNIQUES AND EQUIPMENT FOR ROCKET-BORNE SPECTRORADIOMETRIC SYSTEMS Final Report

Eugene K. Dana, Raymond C. Gelinas, Chandler W. Jones, Lawrence Mertz, Merle J. Persky, Geert Wyntjes, and Niels O. Young
Jan. 9, 1963 76 p 8 refs
(Contract AF 19(604)-8016; ARPA Order 30-61)
(AFCRL-63-249)

This review of work directed toward the development and testing of new techniques, instrumentation, and applications for rocketborne spectroradiometric systems includes: (1) the design of two-dimensional data transform systems; (2) the evaluation and improvement of electronic components; (3) research on pulse biasing of detectors; (4) the evaluation and improvement of transverter power supplies; (5) an analysis of the effects of source modulation on performance of radiometric systems with special emphasis on interferometer spectrometers; (6) the design of a logarithmic amplifier; (7) the design and evaluation of internal calibration sources for spectroradiometers; and (8) a study of the characteristics, limitations, and possible application of the "E" series instruments, which include the E-2E radiometer and the E-6 and E-8 spectroradiometers. I.v.L.

N63-16468 Princeton U. Plasma Physics Lab., N.J.
A MONOCHROMATOR WAVELENGTH MODULATOR
Arthur F. Kuckes Jan. 1963 9 p
(Contract AT(30-1)-1238)
(MATT-162)

A technique for modulating the wavelength of a monochromator is described. Using this modulation technique and a phase detection scheme, a method is described whereby the Doppler shift is easily obtained. N.E.A.

N63-16469 Massachusetts Inst. of Tech. Lab. for Nuclear Science, Cambridge
LINE-SEGMENT DETECTOR FOR LINE PATTERNS
Bernard F. Wadsworth Feb. 1962 16 p 2 refs
(Contract AT(30-1)-2098)
(Tech. Rept. 75; NYO-2667; PEPR-1)

This report describes an experiment conducted to determine the possibility of using a direct, analog approach to locate line segments in a pattern consisting of simple straight and curved line structures, and to determine what resolution is possible in a measurement of this type. A prototype device has been constructed which can successfully locate line segments with better than ± 2 degrees resolution, which is considered more than adequate for pattern recognition of bubble-chamber events. Author

N63-16490 Stanford Research Inst., Menlo Park, Calif.
MEASUREMENT OF ENERGY FLUX DENSITY DISTRIBUTION IN THE FOCUS OF AN ARC IMAGE FURNACE
Rodney B. Beyer, Leonard Mc Culley, and Marjorie W. Evans
Mar. 15, 1963 18 p 6 refs
(Contract Nonr-3415(00))

A calorimeter for mapping flux density in a focal volume is described. This design is based on an earlier design by Broido and Willoughby. However, it differs chiefly in two ways. First, it is much smaller in order to permit its placement inside a test specimen chamber. Second, the design provides for an aperture-containing shield which is placed in front of the receiving surface in order to limit the area of beam which is intercepted. The decay constant is 2×10^{-3} sec. Flux densities ranging from 5 cal/cm^2-sec to 20 cal/cm^2-sec can be conveniently measured over intercepted beam areas of from 0.03 cm^2 to 0.2 cm^2. The use of this calorimeter has permitted the determination of the flux density distribution in the focal volume of a double ellipsoidal arc image furnace. I.v.L.

N63-16517 Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho
MATERIALS TESTING REACTOR-ENGINEERING TEST REACTOR TECHNICAL BRANCHES Quarterly Report, Oct. 1-Dec. 31, 1962
J. R. Huffman, D. R. de Boisblanc, R. G. Fluharty, and L. A. Schmittroth AEC National Reactor Testing Station, Mar. 29, 1963 72 p 31 refs
(Contract AT(10-1)-205)
(IDO-16857) OTS: $1.75

Experiments in reactor physics and engineering with the advanced reactivity measurement facility have proceeded by achieving criticality with the reactor using U^{235} with a center-hole equivalent of one fuel element, development of improved reactor fuels and materials, heat transfer and hydraulics, and reactivity studies of cadmium and hafnium, the study of safety bars in the ETR fuel elements, and Monte Carlo studies of resonance integrals. Theoretical nuclear physics studies include: a cross-sections program, nuclear chemistry, theoretical physics, an inelastic scattering program, and decay-scheme studies. Also included is a summary of instrument development programs and a section on applied mathematics and machine computation. D.E.R.

N63-16567 Applied Psychology Corp., Arlington, Va.
OUTDOOR TEST RANGE EVALUATION OF AIRCRAFT PAINT PATTERNS Technical Report No. 7
Apr. 1962 33 p 18 refs
(Contract FAA/BRD-127)

Six paint patterns representing three principles of aircraft-exterior paint patterning were tested on an outdoor test range. Measures were obtained of the detectability of each pattern and the accuracy with which flight attitude could be determined from it. Eleven experienced pilots viewed four sizes of aircraft models against background panels of four different colors, under both clear and overcast skies. Models with patterns were detected more frequently than an aluminum model, but no pattern was exceptionally more detectable than any other. A pattern in which the fuselage was painted white on top, gray on the underside, with a red-orange fluorescent empennage was found to have advantages, indicating it would offer the greatest reliability across a variety of environmental conditions. Author

N63-16597 Atomic Energy of Canada Ltd., Chalk River
A PORTABLE RATE METER FOR MEASURING α AND β ACTIVITY
A. R. Jones Mar. 1963 21 p 5 refs
(CRRD-1109; AECL-1710) Available from Atomic Energy of Canada, Ltd.: $0.50

The instrument which is described in the report, comprises a ratemeter, high-voltage supply and scintillation probe. The probe contains a ZnS:Ag phosphor of amplifier gains and window thicknesses, α and β activity may be measured separately in the presence of one another and in a γ background. γ sensitivity is low, but efficiencies have been computed for different energies. Although it is a line-powered instrument, it can function for eight hours on internal rechargeable batteries for portable use. Salient features of the circuit are described and performance figures given. The setting-up procedure is outlined in an appendix. Author

N63-16606 Rock Island Arsenal, Ill.
INSTRUMENTATION FOR EVALUATION OF ARTILLERY AND ROCKET LAUNCHER PERFORMANCE AT ROCK ISLAND ARSENAL
J. C. Hanson *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26-28, 1962 [1962] p 49-60 (See N63-16603 14-34)

All instrumentation measurements at Rock Island Arsenal under dynamic conditions have been utilized to obtain operating data on performance of research and development prototype weapons and assemblies during proof firing or functioning tests, rather than on a specific material subject to a particular condition of loading. The basic sensing device used for obtaining analogs of dynamic physical phenomena is the electromechanical transducer. Commercial transducers are used for measuring fluid pressure, acceleration, displacement of moving parts, and loads. Special transducers have been designed for measuring artillery recoil displacement, recoil rod, and trunnion loads. Conventional strain gages are used to measure loads and surface strains on various components, movement of parts, and projectile ejection from the barrel. Recording equipment with a frequency response of zero to 600 cps has been found to be adequate for the majority of measurements. Author

N63-16692 Nihon U. Coll. of Science and Engineering, Tokyo (Japan)
A POSSIBILITY OF GIVING A FINITE MASS TO THE GAUGE FIELD
Osamu Hara [1962] 11 p 11 refs
(NUP-63-7)

Based on the premise that a gage invariant result may be obtained by introducing the contribution from the collective mode of the baryons system in the negative energy sea, results are obtained which indicate that the nonvanishing self-energy is equivalent to introducing a finite mass for the gage field. I.v.L.

N63-16759 Bell Aerosystems Co., Buffalo, N.Y.
CALCULATION AND SIMULATION OF THE NOISE ENVIRONMENTS OF A GUIDED MISSILE FOR TESTING OF COMPONENTS
S. Boraas, W. Fricke, and B. Gaviller *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 123–135 16 refs (See N63-16750 14-01)
(Contract DA-30-069-501-ORD-3186)

This paper describes the acoustic testing of a selected missile subsystem. The methods used for calculating the external noise fields, originating from the booster engine and the turbulent boundary layer of a supersonic missile, are discussed. The overall noise level and the spectrum of the booster noise were calculated from similarity laws. The calculation of the same quantities of the boundary-layer noise was based on the local properties of the induced flow. A large reverberant chamber and a spectral synthesizer were used for simulating the calculated noise environments. After measuring the noise reduction through the structure of the missile, suspended inside the reverberant chamber, the internal noise spectrum was calculated and synthesized for functional and fatigue tests of an arm safe device and its components. The behavior during operation was recorded and analyzed. Author

N63-16827 Aeronautical Systems Div. Flight Dynamics Lab., Wright-Patterson AFB, Ohio
AN INVESTIGATION OF THE VIBRATION PROPERTIES OF THE NET CREW SEAT SYSTEM
Richard L. Peterson May 1963 29 p 8 refs
(ASRMDD-TM-63-31)

This report presents the results of an in-house research test program where the low-frequency-vibration characteristics of the net-seat concept were evaluated over a frequency range of one through twenty cycles per second. Two series of vibration experiments are documented. The first series covers vibration experiments using the experimental net-seat delineator with human test subject, and the second series of vibration experiments covers exposure of three human test subjects and one anthropomorphic dummy to low-frequency, high-amplitude sinusoidal vibrations utilizing the prototype net crew support–restraint system. Graphs covering only the second series of vibration experiments are presented and discussed. In addition, figures illustrating the experimental test configurations are included. The data obtained would tend to indicate that the prototype net crew support–restraint system broadens the frequency band where amplification of sinusoidal vibration occurs in the low-frequency vibration spectrum. Author

N63-16853 Barnes Engineering Co., Stamford, Conn.
STUDY OF A TEMPERATURE MEASURING SYSTEM FOR THE 1000°C TO 2500°C RANGE
Guy Moffitt Wright-Patterson AFB, Ohio, Flight Control Lab., Feb. 1962 106 p 70 refs
(Contract AF 33(616)-7479)
(ASD-TR-61-487; AD-274794)

A radiometer, operating in the ultraviolet region was designed and built to automatically measure the surface temperature of a very hot solid surface. The device senses the ultraviolet radiation in the 0.32 to 0.38 micron band, self emitted from a small area on the hot solid surface. The temperature measurement accuracy was investigated for large effective fluctuations of emissivity over a temperature range from 1000° C to 2500° C, using a tungsten strip lamp for calibration reference. Feasibility models were constructed and operated in room-temperature environments. Temperature data were obtained for varying emissivity of molybdenum in oxidizing conditions. Preliminary considerations were investigated for application of the radiometer in high-temperature oxidizing and nuclear-radiation environments in airborne vehicle systems. Author

N63-16856 Space Technology Labs., Inc., Los Angeles, Calif.
SIMPLIFICATION OF INERTIAL COMPONENT TEST EQUIPMENT
W. J. Tallon *In* Air Force Missile Develop. Center Proc. of the AFMDC Inertial Guidance Test Symp., Vol. I, Holloman AFB, 16–17 Oct. 1962 p II-1–II-26 (See N63-16854 14-01)

The study of testing techniques at space technology laboratories has led to the selection of a set of tests which can be standardized and which allows comparisons between different gyroscopic systems and between test results from different test facilities. The reliability of the test equipment has been improved by a process of specialization as to the type of tests conducted with the apparatus, and the versatility of the equipment has been retained with respect to test items that can be accommodated. This philosophy also reduces equipment costs. A recommendation is made that the trend toward complexity of all test equipment be reversed to adopt a policy of equipment simplicity, to increase the effectiveness of inertial component evaluation. D.E.R.

N63-16858 Air Force Missile Development Center, Holloman AFB, N. Mex.
ACCELEROMETER ERROR COEFFICIENTS DERIVED FROM TRACK TESTS
Forrest R. Hanvey, Jr. *In its* Proc. of the AFMDC Inertial Guidance Test Symp., Vol. I, Holloman AFB, 16–17 Oct. 1962 p IV-1–IV-28 7 refs (See N63-16854 14-01)

It is recommended here that a dynamic simulation be undertaken to prove that acceptable gyro error coefficients can be obtained from track-test data as they can be obtained from a model equation. A hybrid concept is presented to permit the instrumentation of an accurate sled velocity measuring system, and a recommendation of applying a digital computer to the process of calibration of inertial accelerometers is made. Finally, the space–time

system survey is discussed and it is found that this area and the space-time interrupter are the fundamental limitations to present track-test comparison accuracies. D.E.R.

N63-16862 Air Force Missile Development Center, Holloman AFB, N. Mex.
THE SPACE-TIME MEASURING SYSTEM OF THE HOLLOMAN TRACK
W. M. Sanders *In its* Proc. of the AFMDC Inertial Guidance Test Symp., Vol. I, Holloman AFB, 16–17 Oct. 1962 p VIII-1–VIII-19 43 refs (See N63-16854 14-01)

The velocity measuring system of the Holloman track for testing inertial guidance systems is described. Included are: equipment design, equipment operational results, problem areas, and recent system development. The velocity measuring system is now the most accurate available and is sufficient for the testing of guidance systems. Effort is being made to increase the accuracy and reliability of the system to meet future demands of guidance systems. D.E.R.

N63-16874 Union Carbide Research Inst., Tarrytown, N.Y.
A HIGH TEMPERATURE FURNACE FOR QUANTITATIVE X-RAY INTENSITY MEASUREMENTS
C. R. Houska and E. J. Keplin Apr. 1963 23 p 3 refs
(Contract DA-30-069-ORD-2787)
(C-14)

The construction of a high-temperature diffractometer furnace for quantitative X-ray intensity measurements to above 2000° C is described. The details include descriptions of a new sample holder, the hot-zone geometry and assembly, the radiation shielding, direct temperature measurement, and a continuously adjustable, specimen-rocking device. Emphasis has been placed upon flexibility and reliable high-temperature operation. Although the system is operated with a Siemens diffractometer, it could be used with any diffractometer operating on a horizontal plane.
Author

N63-16886 Rensselaer Polytechnic Inst., Troy, N.Y.
A GATED RADIOMETER FOR PLASMA AFTERGLOW STUDY Technical Report No. 7
W. C. Taft, K. C. Stotz, and E. H. Holt Apr. 1963 30 p 8 refs Submitted for Publication
(NASA Grant NsG-48-60) OTS: $2.60 ph, $1.10 mf
(Plasma Res. Lab. Tech. Rept. 7)

In order to monitor the electron temperature during plasma afterglow experiments, a gated microwave radiometer has been developed. The radiometer differs from the usual Dicke type of radiometer in the input switching scheme and by the fact that a good time resolution is required. The radiometer described has a time resolution of one microsecond and a temperature sensitivity of about ten degrees K when measuring temperatures near room temperature. The response time, when used with a repetitive afterglow, is 20 seconds. Measurements of electron temperature in a decaying nitrogen plasma have been made during the initial 300 microseconds of the afterglow. Author

N63-16893 Airlines Communications Administrative Council. Airlines Electronic Engineering Committee, Washington, D.C.
AIRBORNE DISTANCE MEASURING EQUIPMENT-(DME)
Washington, D.C., Aeronautical Radio, Inc., June 28, 1962 114 p
(ARINC Characteristic No. 521C)

This supplement to ARINC *Characteristic* No. 521B gives performance requirements for the airborne distance measuring equipment. N.E.A.

N63-16980 Naval Air Development Center. Aeronautical Electronic and Electric Lab., Johnsville, Pa.
URETHANE FOAMS FOR AEROSPACE APPLICATION Technical Note
H. R. Moore Mar. 2, 1962 31 p refs
(NADC-EL-N6208)

Preliminary tests of one-part frozen urethane powders exposed in a high-altitude vacuum chamber operated at temperatures of −50° and 70° F have shown that a new group of triol-free branched polymers, esterified short of the critical degree of esterification, are capable of producing rigid foams with strength properties comparable to those obtained by high-temperature curing at atmospheric pressure. Controlled, reduced temperature, premixing of three categories of several two-part urethane systems, before rapid freezing in liquid nitrogen, was considered a significant factor in trapping sufficient exotherm of isocyanate cross-linking reactions to initiate foaming in a low-temperature and vacuum environment.
Author

16 LIFE SCIENCES

Includes: biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness.

***For related information see:* 14 Human Behavior; and 28 Space Radiation.**

N63-16352 Naval Radiological Defense Lab., San Francisco, Calif.
DIFFERENTIAL RADIOSENSITIVITY OF FIRST- AND SECOND-SET RESPONSES TO ALLOGENEIC AND XENOGENEIC SKIN GRAFTS IN SUBLETHALLY IRRADIATED MICE
M. L. Tyan and L. J. Cole Apr. 15, 1963 13 p 5 refs
(USNRDL-TR-636)

Data are presented demonstrating the differential radiosensitivity of the first- and second-set responses of sublethally irradiated (670 rad) mice previously sensitized with allogeneic (H-2 difference), xenogeneic (rat), or both allogeneic and xenogeneic skin grafts. The second-set response is more radioresistant than is the first-set response; the second-set response to a xenogeneic graft remains intact during and following recovery from the effects of sublethal irradiation; while intact for a brief period following irradiation, the second-set response to an allogeneic skin graft was abrogated by sublethal irradiation (670 rad); concurrent presensitization with allogeneic and xenogeneic skin grafts prevented the abrogation of the second-set response to the allogeneic graft by sublethal irradiation; the first-set response to an allogeneic graft recovered from the effects of sublethal irradiation prior to the recovery of the first-set response to a xenogeneic graft. Author

N63-16369 Martin-Marietta Co. Space Systems Div., Baltimore, Md.
A CHRONOLOGICAL BIBLIOGRAPHY ON THE BIOLOGICAL EFFECTS OF IMPACT [1876-1961]
Carl C. Clark, Denis Faubert, and Bruce Cooper May 1962 169 p 1147 refs
(Martin Eng. Rept. 11953 (Rev.))

N63-16409 Washington U. School of Medicine, St. Louis, Mo.
CUMULATIVE AUDITORY EFFECTS RESULTING FROM MULTIPLE EXPOSURE TO INTENSE ACOUSTIC STIMULATION. PART II. HISTOLOGICAL EFFECTS OF INTENSE SOUND ON THE INNER EAR [Final Report]

W. P. Covell. Wright-Patterson AFB, Ohio. Biomedical Lab., Jan. 1963. 18 p. 5 refs.
(Contract AF 33(616)-3637)
(AMRL-TDR-62-99 (II)) OTS: $0.50

Thirty-three cats were subjected to sound exposures, and auditory threshold shift measurements as reported in Part I. The animals were subsequently sacrificed and their inner ears prepared for microscopic examination for evidence of tissue injury. The histological findings of injuries are reported in this report. Wide band noise at 155 db for one-half hour produced mild injuries; for 2-hour exposures the injuries were moderate to severe; for 8-hour exposures there were severe injuries. Postexposure lives of these animals were 80 to 90 days. Animals sacrificed 2 to 4 hours after exposure showed essentially the same degree of injury with the same 2-hour exposure as above. Two hours total exposure at 115 db, divided into 16 doses of 7.5 minutes each, with one hour interexposure intervals, resulted in slight to moderate changes. The same total energy in the same number of doses for 7.5 minutes, with an interexposure interval of 6 hours, produced comparatively slight injuries. While considerable variability is evident in different specimens subjected to the same exposure for the same length of time, there persists a general trend for consistency of degree of injury in each group. Author

N63-16421 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE DETAILED COMPOSITION OF FECES, SWEAT, AND URINE: AN ANNOTATED BIBLIOGRAPHY
Charles M. Pierce, comp. Mar. 1962. 225 p. 598 refs.
(Special Bibl. SB-62-56)

The increased importance of closed-cycle life-support systems has produced a need for accumulating information on byproducts of human metabolism. This publication consists of 598 references covering the composition of feces, sweat, and urine. Topics which are discussed include methods of analysis; the constancy at which the formed or waste products are created; and the relative influence exerted thereon by diet, climate, body activity, and stress. Most of the references were published between January 1957 and June 1962. Author

N63-16466 Martin Co. Space Systems Div., Baltimore, Md.
TERMINOLOGY, BIBLIOGRAPHY AND INFORMATION UTILIZATION PROBLEMS IN AEROSPACE BIOPHYSICS
Carl Clark. Apr. 1963. 9 p. 10 refs. Presented at the Symp. on Chem. Lit. of Space Tech., Natl. Meeting of the Amer. Chem. Soc., Los Angeles, Apr. 1, 1963
(ER-12923)

Discussions on certain information utilization problems in manned spaceflight include: (1) the need for information processing computers, (2) the further development of language or terminology adaptable to computer utilization, and (3) the development of instrumentation with associated computer memory for data sorting, processing, and reduction. I.v.L.

N63-16508 Aerospace Medical Div. School of Aerospace Medicine, Brooks AFB, Tex.
AN IN VIVO METHOD TO MEASURE RELATIVE BLOOD VISCOSITY AND FACTORS ASSOCIATED WITH HINDRANCE
Robert M. Olson. Feb. 1963. 13 p. 6 refs.
(SAM-TDR-62-128)

A vascular bed was connected to a pressure generator and recording system by fluid connections. At rest the vascular bed was perfused by the animal itself, but during the two or three seconds of an experimental run, the perfusion pressure was supplied solely by the pressure generator. The apparatus was so constructed that the flow rate was proportional to the rate of change of pressure. The shape of the curve of pressure versus time was determined solely by total resistance in the vascular bed. When conditions were set up so that vessel configuration was held constant, changes in total resistance were due solely to changes in viscosity. Blood viscosity as a function of hematocrit was determined by this method and was found to agree with the data found by Whittaker and Winton. The study of factors associated with hindrance, such as elastic coefficients of vessel walls, geometry of vascular bed, and critical closure phenomenon, depends on the ability to measure instantaneous values of vascular resistance under conditions of varying perfusion pressure. Author

N63-16527 Federal Aviation Agency. Civil Aeromedical Research Inst., Oklahoma City, Okla.
AN ANALYSIS OF SITTING AREAS AND PRESSURES OF MAN
J. J. Swearingen, C. D. Wheelwright and J. D. Garner. Jan. 1962. 12 p.
(CARI-62-1)

Studies of sitting area on a plane rigid surface for a group of 104 male subjects were made. Area was found to vary with height and weight and to increase with age up to 40 years, after which there is a steady decline. Means were 179.4 sq. in. for area and .92 pounds/sq. in. for average pressure. Sitting contact area was found to increase with experimentally applied force of magnitudes up to something less than body weight. Analysis of pressure distribution in the sitting area reveals that nearly half of the body weight is supported on 8% of the sitting area. This high-pressure area is under or adjacent to the ischial tuberosities. Over one-third of the body weight on the sitting area is removed by the addition of a footrest, chair arms, and a slightly sloping seat back. Author

N63-16557 Duke U., Durham, N.C.
CARDIOPULMONARY RESPONSES TO HYPOTHERMIA AND CERTAIN OTHER ENVIRONMENTAL STRESSES [Final Report, Sept. 1960-Oct. 1962]
F. G. Hall and J. V. Salzano. Wright-Patterson AFB, Ohio. Biomedical Lab., Mar. 1963. 50 p. 31 refs.
(Contract AF 33(616)-6803)
(AMRL-TDR-63-19) OTS: $1.50

Respiratory regulation was studied at normal and subnormal body temperatures. Hypoxia and body temperature were found to operate reciprocally in determining utilization of oxygen in a closed environment. Respiratory and circulatory responses to imposed tracheal obstruction were studied in normothermic and hypothermic anesthetized animals. These responses were found to be related to the degree of hypoxia which developed rather than to body temperature per se. Changes in anatomical and physiological dead space were also measured during reduction of body temperature. There were only small changes in respiratory dead space. No significant impairment of gas transport occurred at body temperatures as low as 28° C. Reflex activity was also studied in normothermic and hypothermic animals. Hypothermic animals retain reflex activity but the magnitude of the responses is less than at normal body temperature. The augmented response to norepinephrine was greater than that for epinephrine during reduction in body temperature to 28° C. Vagal reflexes also operate at body temperatures as low as 28° C. Animals respond to carbon dioxide stress essentially in the same way in the hypothermic as in the normothermic state, but at a lower magnitude. Author

N63-16582 Cornell U. Agricultural Research Service, Ithaca, N.Y.
THE ENERGY BUDGET AT THE EARTH'S SURFACE: ENERGY AND WATER BALANCE IN PLANT COMMUNITIES

Edgar R. Lemon Oct. 1962 42 p Presented at the Symp. on Environmental Control of Plant Growth, Canberra, Australia, Aug. 27, 1962
(USAEPG Cross Service Order 2-62)
(Paper 590; Interim Rept. 62-9; Res. Rept. 359)

A general review of the thermal energy and water balance in plant communities is presented. The radiation distribution within a vegetative canopy is presented in terms of the visible and near infrared of the solar radiation and the thermal radiation. The evapotranspiration is treated in terms of the availability of water in the soil and the influences of turbulent transfer. The photosynthesis efficiency and the role of photosynthesis in the thermal energy balance, are also discussed. Author

N63-16706 Martin Co., Baltimore, Md.
TERMINOLOGY, BIBLIOGRAPHY AND INFORMATION UTILIZATION PROBLEMS IN AEROSPACE BIOPHYSICS
Carl Clark Mar. 1963 6 p 10 refs Presented at the Symp. on Chemical Literature, Nat. Meeting of the Am. Chemical Soc., Los Angeles, Apr. 1, 1963
(Eng. Rept. 12923)

Information utilization problems associated with manned spaceflight are discussed. Information processing computers are required for the collation, sorting, and processing of scientific data with the accuracy, inclusiveness, and feedback responsiveness necessitated by technological advances. The growing technological language hopefully will use terms which can be utilized by the computer. Since information transfer is required in both directions between the spacecraft and the ground station, the need for data processing and generalized memory systems onboard the spacecraft is determined by the extent to which the communications link can fail and the availability of adequate information transfer rates. Examples are given of the information processing effort that will be required; these include spacecraft maintenance and repair, and identification of chemical and biological discoveries. The advantages of transmitting analyzed data rather than primary instrumentation data indicate the role of machine memories, or standard data pools, which relate the primary data to all other information available on the subject and indicate the probabilities of accuracy of the derived data. The addition of information-processing computer memory systems to the spacecraft frees the astronaut to pursue his human capabilities for selecting goals, investigating the unexpected, and appreciating beauty. M.P.G.

N63-16837 National Research Council. Committee on Polar Research, Washington, D.C.
SCIENCE IN THE ARCTIC OCEAN BASIN
Laurence M. Gould et al 1963 58 p 14 refs
(NAS-NRC Publ. 1086)

This report is focused entirely on the Arctic Basin, or the north polar sea, and considers the needs for biological and medical research in the Arctic Basin that will best advance an understanding of the environment and life peculiar to the past, present, and future conditions of this area. Topics discussed are: marine botany, marine invertebrates ichthyology, orinthology, mammalogy, entomology, microbiology, physiology and medicine, and ecology. Also presented are the following papers: (1) Arctic Ocean Basin Research, (2) Heat and Water Budget of the Arctic, (3) Geophysics in the Arctic Ocean Basin, (4) Geodetic and Cartographic Aspects, and (5) Arctic Research in the Upper Atmosphere. I.v.L.

N63-16849 Royal Norwegian Air Force. Inst. of Aviation Medicine, Blindern
NON-ESTERIFIED FATTY ACIDS IN VENOUS BLOOD UNDER DIFFERENT EXPERIMENTAL CONDITIONS—OF SPECIAL INTEREST FOR FLYING
F. Vogt. Lorentzen Mar. 1963 8 p 9 refs
(FMI-63-1)

The nonesterified fatty acid levels in venous blood under various physiological conditions were investigated in males aged 18 to 30. The experimental conditions, all of which could be related to actual conditions encountered in flight, included: exercise and the recovery period immediately following cessation of exercise, hypoxia, exercise and hypoxia combined, hypercapnia, hyperventilation and sodium bicarbonate, and pure oxygen breathing. The results indicate a great variation in the normal levels, a great difference in the concentrations from time to time in a single person under the same conditions, and a great irregularity in the curves for different individuals under the same conditions. The conclusion is drawn that well-trained subjects or anaesthetized animals should be used in further nonesterified fatty acid level studies to eliminate the effects of varying adrenal secretion. M.P.G.

N63-16868 California U., Los Angeles. School of Medicine
SEPTAL AND HYPOTHALAMIC STIMULATION OF UNANESTHETIZED CATS Technical Documentary Report
D. G. Stuart, Y. Kawamura, and A. Hemingway Wainwright, Alaska, Arctic Aeromedical Lab., Sept. 1962 24 p 13 refs
(Contract AF 41(657)-344)
(AAL-TDR-62-14)

Bipolar stainless-steel electrodes were stereotactically implanted in septal and hypothalamic loci, in six cats. Observations were made of autonomic, somatomotor, and behavioral responses to electrical stimulation delivered while the cats were unanesthetized and unrestrained. Septal stimulation evoked sympathetic and parasympathetic responses in varying combinations on various days; this suggests that responses to septal stimulation were influenced by the relative excitability of anterior and posterior hypothalamic neurons at a given time. Shivering was produced during stimulation of both septal and hypothalamic loci, thereby confirming previous results obtained from anesthetized preparations. Author

N63-16929 Feltman Research Labs., Picatinny Arsenal, Dover, N.J.
MAN AND RADIATION
Rudolph Schulze May 1962 22 p Transl. into ENGLISH from Lichttechnik (Vienna), v. 12, 1960 p 443–448
(FRL-TN-90; AD-278083)

The effects of radiation on man are discussed. The different types of radiation to which man is subjected are examined, the intensities and fluctuations are noted, and the effect on the human organism of the various types is investigated. The following are discussed: radiation sources and types and irradiation intensity, cosmic radiation of the stars, natural and artificial radioactivity, ultraviolet radiation of the sun, visible light of the sun, high-frequency radiation from the stars, infrared radiation of the atmosphere, and high-frequency radiation of the atmosphere. D.E.R.

17 MACHINE ELEMENTS AND PROCESSES

Includes: bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; and materials fabrication, handling, and inspection.

For related information see: 06 Auxiliary Systems.

N63-16410 Frankford Arsenal, Philadelphia, Pa.
DEVELOPMENT OF RELEASE BOLT, NONFRAGMENTATION
R. C. Sutter June 1962 22 p
(FA-R-1645; AD-291769)

A project was initiated to develop a nonfragmentation bolt to replace the common explosive bolt. Specifications for the explosive bolt on the clamp ring of Project Mercury were used as a guide. The design selected was one that utilized two shear pins as retention members on the bolt. By changing the materials and hardness of these pins, release bolts of many different strengths could be developed. The basic design utilized T14E2 ignition elements as the source of propellent gas for separation of the bolt. The release bolt developed offers the prime advantage of separating without external fragmentation. This design is flexible and can be applied to standard cap-screw designs. It can be used in place of most existing types of explosive bolts. Further, the electric-ignition element can be modified to incorporate necessary additional propellant charge to reduce the complexity of the design as it now stands. Author

N63-16411 Hanford Atomic Products Operation, Richland, Wash.
CERAMICS RESEARCH AND DEVELOPMENT OPERATION Quarterly Report, Oct.-Dec., 1962
E. A. Evans May 16, 1963 122 p 1 ref
(Contract AT(45-1)-1350)
(HW-76300) OTS: $2.50

Progress is reported in the fields of ceramics research, fuels development, and plutonium metallurgy. Areas include: work on plutonium sulfides, plutonium mononitride and carbide, properties of sintered thorium–plutonium oxides, plutonium oxide–carbon reaction, phase studies of plutonium oxide–magnesium oxide and thorium oxide systems, uranium and uranium–tungsten cermets, fuels development, fabrication, compaction and facilities, and testing and analyses of fuels. D.E.R.

N63-16496 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
HIGH-TEMPERATURE OXIDATION-RESISTANT COATINGS FOR TANTALUM BASE ALLOYS [Final Report, 1 Nov. 1961-30 Nov. 1962]
L. Sama Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Feb. 1963 148 p 14 refs
(Contract AF 33(657)-7339)
(ASD-TDR-63-160; TR-62-460.7)

The effect of coating composition on structural changes and oxidation behavior was studied using a Sn-Al spray-slurry system with tantalum, tantalum alloys, columbium, tungsten, and molybdenum. In tests conducted at 3000° F, it was found that increased oxidation protection was most significantly related to the thickness of the tin-rich phase at the surface. The use of refractory metal-powder additives plus excess aluminum to form aluminide particles served best to increase the thickness of this phase. Coating composition was optimized and an extensive evaluation was carried out with TA-10%W, TA-30%Cb-7.5%V, and Cb-5%Zr. In oxidation tests at 1100° to over 3000° F, protective life was significantly affected by substrate composition, coating thickness, and thermal cycling. Tensile and stress-rupture data were obtained on coated samples at 2000° to 3000° F and correlated fairly well with data in the literature for uncoated material. Preliminary studies were made of coating stability at air pressures in the micron to millimeter range. Oxidation and diffusion effects were explored by metallographic electron probe and X-ray analysis. A brief study of TA-10Hf-5W in contact with Al_2O_3 at elevated temperatures showed that this alloy was unstable in contrast to pure tantalum, Ta-10W, and TA-30Cb-7.5V, which were quite stable. Oxidation data were obtained for several tantalum alloys coated with Ti-Si. A diluent system was sought for beryllide-type coatings in which Sn, Cu, Si, and Ag were investigated. The use of silver as a slurry base was found to be most promising, but was not extensively evaluated. Author

N63-16524 Aberdeen Proving Ground, Coating and Chemical Lab., Md.
INVESTIGATION OF RESIN MODIFIED TWO PACKAGE WASH PRIMERS
Stanley F. Koutek May 3, 1963 18 p
(CCL-143)

This report covers the evaluation of resin-modified, two-package wash primers. Wash primer conforming to MIL-C-15328A was modified with heat-reactive, non-heat-reactive and terpene-phenolic resins, vinsol ester, chlorinated biphenyl, urea formaldehyde, and high-acid-number hard resins. These primers were subjected to salt spray and water immersion tests on steel, aluminum, and magnesium. Test data indicated that the heat-reactive phenolic-resin modifications initially prepared offered better resistance to water immersion than the specification wash primer. However, on aging, they became less resistant to water immersion than MIL-P-15328A. No advantages were apparent for other resin modifications. Author

N63-16540 Illinois U., Urbana
PLAIN AND DEFORMED WIRE FABRIC IN CONCRETE
Russell S. Jensen, Albert C. Bianchini, and Clyde E. Kesler Feb. 1963 51 p refs
(Sponsored by Am. Steel and Wire Div. of U.S. Steel Corp.)
(T&AM-238)

The basic objective of this series of tests was to determine the behavior and mode of failure of reinforced concrete members when reinforced with deformed welded wire fabric, and to compare the results with those of members reinforced with standard welded wire fabric. The investigation was carried out in two parts: (1) pull-out studies and (2) slab studies. The following variables were included in the tests: welded wire fabric using 3 different surface patterns, spacing of transverse wires, size of transverse wires, weld strengths, and longitudinal and transverse wires clipped together rather than welded. For the welded wire fabric, the following surface patterns were investigated: smooth, wire deformed on two lines, and wire deformed on four lines. I.v.L.

N63-16618 Picatinny Arsenal, Dover, N.J.
HIGH LOADING RATE TESTING MACHINE, DEVELOPMENT AND TYPICAL MATERIALS TESTING APPLICATIONS
T. M. Roach, Jr. *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 341–358. 3 refs
(See N63-16603 14-34)

This paper covers the design, development, and testing applications of a high-loading-rate tensile-testing machine. The testing machine is capable of making tension or compression tests in which the time to reach a desired stress level may be varied from one second down to five milliseconds. It is possible to apply a preset value of stress and maintain this stress at a constant level until yielding of the specimen occurs. Tests to fracture may also be performed and stresses up to 300,000 psi may be applied to a .250-inch-diameter specimen. Provisions are provided for testing specimens at various temperatures from −65° to 300° F. A number of special carburized steel specimens were taken to fracture in the low-millisecond time range, in order that the effects of carburization depth could be assessed. The results of this series of tests are reported. Also discussed are the dynamic tests performed on two component items, shot-start and shock screw, and several pearlitic malleable-iron specimens. Author

N63-16619 Watertown Arsenal. Materials Engineering Lab., Mass.

A MEDIUM-SPEED TENSILE TESTING MACHINE AND ITS PERFORMANCE IN TESTING OF SOME ORDNANCE MATERIALS

A. G. H. Andersen *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 359–395 2 refs (See N63-16603 14-34)

A pneumatic tensile tester, recently designed and built at Watertown Arsenal Laboratories, has a load capacity of 12,000 pounds and an idling speed of about 300 in./sec. over a 3-inch stroke, at 500-psi nitrogen, or less than half the allowable maximum pressure. Loads and strains may be recorded by oscillographs or oscilloscopes. The scope can be triggered through an electric circuit by an internal, automatic poppet valve in the main gasport. External, auxiliary diaphragm valves are actuated by solenoids. Excess energy of piston assembly, after a tensile rupture, is absorbed through rapidly damped oscillations between two air cushions at opposite ends of the cylinder. The machine is mounted on a carriage resting on springs and Barrymounts so that operation at full load transmits negligible vibrations to the floor. Weight of machine and carriage is 700 pounds; base, 600 pounds; and steel safety cabinet, 400 pounds. Short descriptions and a number of illustrations are presented which show typical actions of the machine and results of various tests recently performed on ordnance materials. Author

N63-16669 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

CALIBRATION OF A THERMAL-CONDUCTIVITY VACUUM GAGE IN THE RANGE OF 10^{-4} TO 1 TORR BY MEANS OF A VOLUME-RATIO CALIBRATION SYSTEM

Raymond Holanda Washington, NASA, June 1963 27 p 9 refs (NASA TN D-1729) OTS: $0.75

Pressure measurements obtained with the thermal-conductivity gage were reproducible to about 1 percent to the lower limit of 10^{-2} torr and to 2 percent to the lower limit of 10^{-4} torr. Calibration curves for several gases are presented. Pressures in the range of 10^{-4} to 1 torr were accurately created by the injection of a small volume of relatively high-pressure gas into a large chamber that was initially at substantially zero pressure. An error analysis showed that pressures as low as 2×10^{-4} torr could be produced with a maximum limit of error of 3 percent; below 2×10^{-4} torr, the limit of error increased linearly to 6 percent at 10^{-4} torr. Author

N63-16757 Lockheed Missiles and Space Co., Sunnyvale, Calif.

A METHOD FOR SELECTING OPTIMUM SHOCK AND VIBRATION TESTS

R. E. Blake *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 88–97 7 refs (See N63-16750 14-01)

Measurements from test have shown a tremendous scatter for successive flights at the same pickup location. The cause of this scatter, ranging over factors such as 4:1, is still unknown and yet designs must be made, tested, and qualified. This data scatter has led to the use of Decision Theory to find a rotational solution in the face of uncertainty. Author

N63-16773 Westinghouse Electric Corp., Sunnyvale, Calif.

ANALYTICAL CONSIDERATIONS IN THE DESIGN OF A POLYURETHANE FOAM SHOCK MOUNT FOR POLARIS

W. A. Volz *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 265–271 1 ref This paper was not presented at Symp. (See N63-16750 14-01)

This paper discusses pertinent aspects of designing a polyurethane foam shock mount, and presents a mathematical model to simulate the mount's dynamic performance. Author

N63-16788 Rome Air Development Center. Applied Research Lab., Griffiss AFB, N.Y.

THE RELIABILITY ANALYSIS OF NONELECTRONIC COMPONENTS

Donald W. Fulton Mar. 1963 34 p 9 refs (RAS-TM-63-2)

The estimation, analysis, and demonstration of satisfactory performance of mechanical and electromechanical equipment are discussed. It is found that a reliability statement for such components must include time as a factor, for it is found that failure varies with time, but the statement must also include a random factor accounting for random failure. Then a statement for reliability is given: $R(t) = f(t) \times \eta$. A casual analysis method of studying failure is given as the best approach to reliability prediction. D.E.R

N63-16871 Armour Research Foundation, Chicago, Ill.

STUDY OF COMPREHENSIVE FAILURE MECHANISMS THEORY Interim Progress Report No. 1 [26 Feb. 1962–25 Nov. 1962]

M. E. Goldberg, comp. [1962] 64 p 11 refs (Contract AF 30(602)-2731)

CONTENTS:

1. FAILURE PHYSICS: AN ESSENTIAL DISCIPLINE FOR RELIABILITY ENGINEERING Levinson and G. Pohl p D1–D22 6 refs (See N63-16872 14-17)

N63-16872 Armour Research Foundation, Chicago, Ill.

FAILURE PHYSICS: AN ESSENTIAL DISCIPLINE FOR RELIABILITY ENGINEERING (APPENDIX D)

David W. Levinson and Robert G. Pohl *In its* Study of Comprehensive Failure Mechanisms Theory Interim Progress Rept. No. 1 [26 Feb. 1962–25 Nov. 1962] p D1–D22 6 refs Presented at the Symp. on the Phys. of Failure in Electronics, Chicago, Sept. 26–27, 1962 (See N63-16871 14-17)

This paper advances the theory that a change in the performance of a component with time occurs as the result of natural processes that can be described by well-known laws. So, it is postulated that fatigue and failure can be predicted. If such a prediction is to be made on a quantitative basis, one must verify the operative mechanisms and obtain appropriate rate constants. Then a high-speed computer can be used to extrapolate data received. This may reduce the need for extensive proof testing, if the computer is used in conjunction with analytical modeling. D.E.R.

N63-16973 Rome Air Development Center. Applied Research Lab., Griffiss AFB, N.Y.

STATISTICAL DESIGN TECHNIQUES

Jerome Klion May 1963 19 p 33 refs (RADC-RAS-TM-63-3)

The reliability of electronic circuits is investigated and statistical techniques are applied to component design. Methods and development of the approach to statistical design techniques are presented in three stages. C.L.W.

18 MATERIALS, METALLIC

Includes: cermets; mechanical and physical properties of alloys and metals; and metallurgy.

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Non-metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-16345 Lockheed Missiles and Space Co., Sunnyvale, Calif.
BERYLLIUM: AN ANNOTATED BIBLIOGRAPHY, JULY-SEPTEMBER 1962–SUPPLEMENT II
Jack B. Goldmann Apr. 1963 62 p 140 refs
(Contract NOrd-17017)
(Special Bibl. SB-62-22, Suppl. II)

The annotated bibliography covers publications released during the third quarter of 1962. Citations are arranged alphabetically by author under the broad subject headings of Alloys, Analysis, Applications, Bibliographies, Compounds, Corrosion, Fabrication Techniques, Joining, Mineralogy, Oxides, Powder Metallurgy and Casting, Processing, Properties, and Miscellaneous. Author

N63-16356 Johns Hopkins U., Baltimore, Md.
THE EFFECT OF METAL PROPERTIES ON HYPERVELOCITY PENETRATION Progress Report No. 5, December 1, 1962-March 1, 19f 3
Robert B. Pond Mar. 1963 5 p
(Contract DA-36-034-ORD-3565 RD)

A device for directly measuring the strain gradients in metals subjected to hypervelocity penetration is being designed and constructed. This device is based upon the development of a three-dimensional array of nickel markers inside a copper target. A loom has been devised with pin spacings which control the nickel wire spacings to 1/4 inch. The north-south wires are first tightly strung and then the east-west wires are woven into the original series. A thin wall steel ring 1/4 inch high is glued to the wires with Eastman 910 cement and the wires are subsequently cut from their spacing posts, forming a cemented array. A number of these rings will be stacked up so that the north-south wires will all be parallel. The ends of the rings thereby making a continuous pipe with a lattice of nickel wires inside. When the molten copper strikes the pipe, it will expand, thereby stretching the wires and preventing sagging. I v.L.

N63-16455 Battelle Memorial Inst., Columbus, Ohio
COATINGS FOR TANTALUM-BASE ALLOYS [Final Report, Jan. 1-Dec. 31, 1962]
J. B. Hallowell, D. J. Maykuth, and H. R. Ogden Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Apr. 1963 87 p
(Contract AF 33(657)-7909)
(ASD-TDR-63-232)

Silicide coatings, applied by pack cementation, were evaluated on a variety of tantalum alloys including Ta-10W, Ta-30Cb-7.5V, and Ta-8W-2Hf. Modification of the silicide, by diffusion with the underlying substrates, resulted in significant differences in oxidation behavior. Similar effects were obtained by incorporating aluminum, boron, and manganese additions in the silicide coating. Of the modifiers studied, vanadium was found to be most beneficial in improving the protective life of silicide coatings at low as well as high temperatures. Straight silicide coating of Ta-30Cb-7.5V alloy had no detrimental effect on room-temperature properties and provided useful lives in dynamic as well as static oxidation testing at 3000° F. Modifications of the silicide with boron and vanadium show further improvements in static oxidation performance at temperatures from at least 1800° through 2900° F. Author

N63-16537 Catholic U. of America, Washington, D.C.
A STUDY OF THE STABILIZATION OF TRANSFORMATIONS IN STEELS. THE EFFECT OF TWO-STEP HEAT-TREATMENT AND ULTRASONIC IRRADIATION DURING QUENCHING ON THE HARDENABILITY OF 4340 STEEL Technical Report
Jing-Ming Lin (M.S. Thesis) and E. P. Klier Mar. 31, 1963 19 p 15 refs
(Grant DA-ARO(D)-31-124-G417)
(AROD-2581-2)

The end-quench bar hardenability data for 4340 steel direct quenched from austenitizing temperatures in the range 1400° to 1550° F are reported. In comparison, parallel sets of specimens were first cooled in furnace to 1350° F and then quenched. Certain of the tests indicated above were repeated with the specimen ultrasonically irradiated. For the 4340 steel studied, the two-step austenitizing treatment promoted a slight increase in hardenability, while for all heat-treating cycles, ultrasonic irradiation led to reduced hardenability. The metallographic structures developed in the respective specimens are discussed. Author

N63-16545 Fansteel Metallurgical Corp., North Chicago, Ill.
COLUMBIUM ALLOY SHEET ROLLING PROGRAM Interim Report No. 1, Mar. 7, 1963 through May 6, 1963
W. O. Gentry and H. A. Moreen May 7, 1963 5 p
(Contract NOw-63-0231-c)

A program has been initiated by Fansteel Metallurgical Corporation for the preparation and evaluation of preproduction quantities of sheet from two "second generation" columbium-base alloys, FS-85 (Cb-27Ta-10W-1Zr) and B-66 (Cb-5V-5Mo-1Zr). This program calls for the production of 150 pounds of each of the alloys in sheet form of .040- to .060-inch thickness from 6-inch-diameter cast ingots, and for the evaluation of the mechanical properties and weldability of the sheet. Author

N63-16564 California U., Livermore. Lawrence Radiation Lab.
ORDERING IN NiMn
James R. Wolfe Jan. 25, 1963 37 p 13 refs
(Contract W-7405-eng-48)
(UCRL-7210) OTS: $0.75

The ordering reaction in NiMn has been followed by X-ray diffraction, metallographic, and resistivity techniques, and is shown to be a heterogeneous phase transformation. The kinetics of the phase transformation have been studied by following the change in resistivity of the alloy during isothermal ordering. The temperature dependence of the transformation can be described by the Arrhenius relationship which leads to an "apparent" activation energy of 50.7 kcal for the reaction. The time dependence of isothermal ordering is not describable in terms of a single reaction-rate equation. Author

N63-16566 California U., Livermore. Lawrence Radiation Lab.
FUTURE TRENDS IN BERYLLIUM METALLURGY RESEARCH
Rointan F. Bunshah Mar. 29, 1963 27 p 26 refs
(Contract W-7405-eng-48)
(UCRL-7289) OTS: $0.50

Commercial beryllium is not a relatively pure metal, but a very complex alloy. A review of its nature and limitations is presented. The effects of purification strongly suggests that impurities in commercial Be cause brittleness and limit its potential applications. Future research trends are discussed. Author

N63-16569 Martin Co., Baltimore, Md.
A STUDY OF THE EFFECT OF SURFACE FILMS ON THE MECHANICAL PROPERTIES OF METALS [Semi-Annual Progress Report]

Irvin R. Kramer Wright-Patterson AFB, Ohio, Air Force Systems Command, July 1962 22 p 8 refs
(Contract AF 33(616)-7976; S/A 2(62-356))

A study was made of the effect of the surface conditions on the activation energy of aluminum crystals. The activation energy decreased from 4800 to 750 cal/mole when the measurements were made while the surface of the specimens was removed during the tests. The delay time for creep was found to be directly proportional to the decrease in stress and the rate at which the metal was removed. The creep rate of zinc specimens in a solution containing surface-active agents was always lower than that of specimens which had been cleaned just prior to testing. It was concluded that two mechanisms operate at the surface to affect the creep behavior. The oxidized layer increases the creep strength, while the surface-active agent decreases the creep strength by removing metal through the formation of metal soaps. Author

N63-16576 Martin Co., Baltimore, Md.
THE EFFECT OF SURFACES ON THE MECHANICAL BEHAVIOR OF METALS [Final Report, Jan. 1-Dec. 31, 1962]
I. R. Kramer Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Mar. 1963 35 p 10 refs
(Contract AF 33(616)-7976)
(ASD-TDR-63-101)

The activation energies for plastic flow of aluminum, copper, and gold were found to decrease as functions of the rate of metal removal. The decrease in activation energy was largest for aluminum and smallest for gold. As calculated by the usual methods, the activated volume for aluminum decreases with the polishing rate, however, it is shown that this method of determining the activated volume is incorrect. A study of the metal-recovery process showed that it is associated with the ability of dislocations to escape for the crystal and the relaxation of dislocations in the debris layer. The activation energy at low strains for aluminum crystals is related almost entirely to the debris layer. Author

N63-16586 Defense Metals Information Center, Battelle Memorial Inst., Columbus, Ohio
BINARY AND TERNARY PHASE DIAGRAMS OF COLUMBIUM, MOLYBDENUM, TANTALUM, AND TUNGSTEN
J. J. English Feb. 7, 1963 139 p 92 refs
(Contract AF 33(616)-7157)
(DMIC-183; suppl. to DMIC-152)

This report contains a compilation of binary and ternary phase diagrams of the four refractory metals—columbium, molybdenum, tantalum, and tungsten. Included with each binary diagram and with some ternary diagrams is a short discussion which lists information such as maximum solubility and crystal structures of intermediate phases. Author

N63-16598 Nuclear Corp. of America. Research Chemicals Div., Phoenix, Ariz.
THE PREPARATION OF HIGH PURITY RARE EARTH METALS BY ZONE REFINING Final Report, Jan. 1, 1962 to Jan. 31, 1963
C. J. Heinink [Apr. 1962] 43 p 11 refs
(Contract AF 19(604)-7491)
(AFCRL-63-36)

An attempt was made to prepare ultra-high-purity rare-earth metals, Samarium, Europium, Gadolinium with total impurities of less than .1 ppm. Methods of separation, reduction, and purification were: ion exchange, dry fluoride preparation, metallothermic reduction, vacuum distillation, zone refining by induction heat, and electron-beam melting. Gas chromatography was investigated as an analytical tool for determination of oxygen in metals. Author

N63-16605 Picatinny Arsenal. Ammunition Group, Dover, N.J.
THE EFFECT OF STATIC AND DYNAMIC LOADING AND TEMPERATURE ON THE YIELD STRESS OF IRON AND MILD STEEL IN TENSION AND COMPRESSION
William Griffel *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26-28, 1962 [1962] p 43-48 (See N63-16603 14-34)

The purpose of this paper is to summarize some of the latest testing results of dynamic stress and deformation in a mild steel in tension at normal and low temperature, and the effect of static and dynamic loading and temperature on the yield stress of iron and mild steel in compression. Author

N63-16609 Army Tank-Automotive Command, Center Line, Mich.
ROLLED ARMOR STEEL BRITTLE FRACTURE TEMPERATURES AND DESIGN SIGNIFICANCE
Victor H. Pagano *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26-28, 1962 [1962] p 107-131 11 refs (See N63-16603 14-34)

This investigation evaluates the brittle fracture integrity of a high-strength, armor steel employed in the manufacture of light combat vehicles. Transition temperature determinations were made on thirty-two heats of 1/2"-thick rolled armor steel plate of two chemical compositions and the same specification hardness range. The variation in Drop Weight Test NDT temperatures for the different heats of Mn-Cr-Mo armor was −50° to −110° F and −80° to −130° F for Mn-Mo armor. Also, FTE and FTP temperature values were obtained from limited crack starter explosion-bulge tests, and used to interpret the safe-operating temperature for anticipated service stressing of the armor structure. From an interpretation of all three transition temperatures, the steels investigated can be expected to perform safely under nominal elastic loads in the presence of notches down to operating temperatures of just above −90° F. If the probability of exposing notch sites to crack initiating (plastic) loads is great, the operating temperature of the armor must be restricted to just above −30° F to safely limit cracking within deformed metal regions. Author

N63-16611 Springfield Armory, Mass.
THE EFFECT OF HIGH RATE LOADING ON THE MECHANICAL PROPERTIES OF ORDNANCE MATERIALS
Alexander Hammer and Hubert Cadle *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26-28, 1962 [1962] p 222-241 (See N63-16603 14-34)

Primary purpose of the investigation, results of which are reported in the paper, is to prove that the mechanical properties of the metals at high rate loading are well above those values which are presently considered by design engineers. The investigation was conducted with a gas system testing fixture in which gas, emitted while firing a gun, is used to initiate pressures in test specimens. In this fixture, cal. 30 barrels were modified to allow the gas to escape through an orifice into a gas cylinder. The size of this orifice, its location along the barrel, the initial volume of the gas cylinder, the movement of piston in the gas cylinder so as to allow its volume to be changed, and the weight of the moving piston are parameters which can be changed to vary the characteristics of the gas pressure in the cylinder. A very important area directly affected by the investigation is lightweight design. It can be proven that the mechanical properties of ordnance materials at actual working conditions are in excess of those which are used at present as design criteria; and it is evident that large numbers of weapon components were overdesigned, that they are too big, and too heavy. Author

N63-16615 Quartermaster Research and Engineering Command, Natick, Mass.
COMPARATIVE FORMING TECHNIQUES FOR TITANIUM HELMETS
Helen E. Agen *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 304–311 (See N63-16603 14-34)

Titanium alloys, on a strength-to-weight basis, offer the best resistance to ballistic penetration of all known metallic armor materials. The feasibility of hot deep-drawing helmet shells from titanium sheet material at a temperature of 1300° F was established. Six helmets were successfully fabricated from 3 percent Mn complex + 4 Al titanium alloy sheet of .075 and .100 gages. Forming was accomplished at elevated temperatures using sand as the transfer medium and pistol powder for the explosive. Ballistic capabilities of the finished helmet shells were evaluated using GE fragment-simulator test. Author

N63-16622 Aberdeen Proving Ground. Ballistic Research Labs., Md.
CORRELATION OF HIGH LOADING RATE REACTIONS WITH LOW RATE TESTS IN METALS
Coy M. Glass *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 438–453 (See N63-16603 14-34)

Changes in a tensile specimen during neck-down, when the load is above the ultimate tensile stress, are found to be functions of the rate of application of load. The neck remains volume constant, and the rate of change of dimensions within this volume may be measured from photographs taken during the test. Analysis of the neck region provides a basis for calculating energy–volume relations as a function of strain rate. Using these relations and a high-velocity stress-strain curve, a prediction may be made of metal reaction under explosive loading. In this paper, annealed polycrystalline copper, and single crystal copper specimens are compared, using the above analysis. In an experimental arrangement using explosives, specimens are necked-down and fractured, and the energy distribution in the stress pulse, during necking and fracture, are compared to the process occurring during slow rate deformation. Author

N63-16667 General Electric Co. Research Lab., Schenectady, N.Y.
EFFECT OF BASIC PHYSICAL PARAMETERS ON ENGINEERING PROPERTIES OF INTERMETALLICS, PART IV [Summary Report, Dec. 1961–Dec. 1962]
J. H. Westbrook and D. L. Wood Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Apr. 1963 28 p 6 refs
(Contract AF 33(616)-7714)
(WADD-TR-60-184, Pt. IV)

A general survey of the effects of dilute ternary solute additions on the flow stress of AgMg has been made. A unique, efficient device to measure ductile–brittle transition temperatures on wire specimens has been designed and built. Using this device, the effects of composition, grain size, strain rate, and ternary solute additions on the transition temperature have been documented for AgMg. Further studies of the kinetics of solute-induced grain boundary hardening indicate that the phenomenon is much more complex than previously supposed. Author

N63-16704 Rice U., Houston, Tex.
THEORY OF DISLOCATION HYSTERESIS WITH APPLICATION TO DAMPING MEASUREMENTS IN MAGNESIUM SINGLE CRYSTALS
J. M. Roberts and D. E. Hartman Repr. from J. Phys. Soc. Japan, v. 18, suppl. 1, 1963 p 119–129 18 refs Presented at Proc. of Intern. Conf. on Crystal Lattice Defects, 1962 Symp.
(NASA Grant NsG-6-59)

The hysteretic damping theory due to Weertman and Salkovitz is modified by (a) taking into account line tension-limited dislocation motion and (b) realization that some dislocation loops can bow further than the mean spacing between solute atoms in the crystal when the applied stress is less than the mean internal stress. The results of an experimental investigation concerning the effect of temperature (in the range 82° to 320° K), frequency (in the range 0.015 to 0.75 cps), prestrain (in the range 0 to 120×10^{-4}) and stress amplitude upon the energy loss associated with damping loops in about 99.96 atomic-percent pure-magnesium single crystals are reported. Quantitative agreement between experiment and the modified Weertman-Salkovitz theory is noted at low temperatures. Qualitative agreement between the behavior of a broad relaxation peak observed at about 225° K, and the theoretically predicted relaxation loss outlined by Weertman, which has been extended to high-stress amplitudes in the present study, is noted. The experimentally observed irregular increase of the decrement with prestrain, in the prestrain range 0 to 50×10^{-4}, is discussed in terms of surface and bulk dislocation sources being operative at various prestrains during this initial stage of deformation.
Author

N63-16705 Rice U., Houston, Tex.
STUDY OF THE BORDONI PEAK IN F.C.C. METALS AFTER DEFORMATION AT 4.2°K AND SUBSEQUENT LOW TEMPERATURE ANNEALING
Shigeo Okuda Repr. from J. Phys. Soc. Japan, v. 18, suppl. 1, 1963 p 187–195 12 refs Presented at Proc. of Intern. Conf. on Crystal Lattice Defects, 1962 Symp.
(NASA Grant NsG-6-59)

The internal friction and dynamic modulus of gold, copper, silver, and platinum were measured in the temperature range from 4° to 300° K after torsional prestrain at 4.2° K and subsequent low-temperature annealing. Pronounced reduction of the heights of the Niblett–Wilks and the Bordoni peaks was observed after the annealing at about 180° K. After room-temperature annealing, the peaks became larger again and after further annealing at higher temperature, the Bordoni peak continued to grow but the Niblett-Wilks peak decayed. The reduction of the heights of the dislocation relaxation peaks during the low-temperature annealing is believed to be due to the migration of point defects to and pinning of the dislocation lines which were produced by the prior plastic deformation. The subsequent growth of the peaks with further annealing is believed to be associated with the disappearance of these pinning points. The measured changes in dynamic modulus were found to be consistent with the above model. It is found that a portion of the dislocations pinned by these defects can be unlocked by additional deformation at 4.2° K. The Bordoni peaks in silver and platinum behave differently from those in gold and copper.
Author

N63-16713 Brown U. Div. of Engineering, Providence, R.I.
THE BEHAVIOR OF METALS AT ELEVATED TEMPERATURES UNDER IMPACT WITH A BOUNCING BALL
C-H. Mok and J. Duffy Apr. 1963 67 p 20 refs
(Contract Nonr-562(20)/33)
(Tech. Rept. 33)

This report describes an investigation into the behavior of metals under impact at elevated temperatures. In a series of tests, a hard spherical ball strikes the flat surface of a massive specimen, which in one instance was a commercially pure lead and in another an aluminum alloy. Tests were made at a number of temperatures, and the velocity of impact and the velocity of rebound were measured, as well as the size of the permanent

indentation in the specimen surface, and the time of contact between ball and specimen. Through dimensional analysis, relations were derived which predict quite accurately the time of contact and the diameter of the permanent indentation for a given material. Author

N63-16714 Directorate of Materials and Processes, Aeronautical Systems Div., Wright-Patterson AFB, Ohio
THE INVESTIGATION OF THE EFFECTS OF LOADING RATE AND STRESS CONCENTRATION FACTORS ON THE NOTCH PROPERTIES OF THREE SHEET ALLOYS AT SUBZERO TEMPERATURES [Final Report, July 1960-Feb. 1962]
A. W. Brisbane Mar. 1963 42 p 13 refs
(ASD-TDR-62-930)

The effect of theoretical stress concentration factors and loading rates at 26°, −78°, and −196° C are presented for 301XH stainless steel, René 41, and Vasco Jet-1000 sheet materials. Author

N63-16727 Illinois U., Urbana
YIELD BEHAVIOR OF POLYCRYSTALLINE NIOBIUM
D. C. Huffaker and G. M. Sinclair May 1963 46 p 27 refs
(Contract AT(11-1)-1046)
(T&AM-244)

The yield behavior of niobium (columbium) has been studied under conditions of different states of stress, temperatures and strain rates, material compositions, and microstructures. The analysis included in this paper shows that a simple parameter representation of yield behavior of niobium is feasible in terms of pertinent engineering variables. Author

N63-16735 General Electric Co. Research Lab., Schenectady, N.Y.
THERMIONIC EMISSION FROM METAL CRYSTALS IN ALKALI METAL VAPORS Scientific Report No. 2
H. F. Webster and P. L. Read May 1963 56 p 35 refs
(Contract AF 19(604)-8424)
(AFCRL-63-451)

Thermionic-emission microscopes have been used to evaluate the emission density from tungsten, molybdenum, tantalum, niobium, nickel, rhenium, and niobium carbide in cesium, rubidium, and potassium vapors as a function of alkali vapor pressure, emitter temperature, and emitter crystal face. It was found that when the emitter surface had less than a monolayer coverage of alkali metal, it was the atomically closest packed plane of the emitter which yielded the highest thermionic-emission density. The effects of surface contaminants were studied, and evidence was obtained suggesting that the high work function of the 112 plane of tungsten and molybdenum may be caused by a contaminant. Author

N63-16783 Catholic U. of America, Washington, D.C.
A STUDY OF THE STABILIZATION OF TRANSFORMATIONS IN STEELS. THE EFFECT OF AUSTENITIZING TEMPERATURE ON THE COOLING TRANSFORMATIONS IN 43XX STEELS Technical Report
E. P. Klier and Jane Jellison Oct. 1962 32 p 14 refs
(Grant DA-ARO(D)-31-124-G129)
(AROD-2581-1)

A series of 43XX steels with carbon contents of from 0.22 to 0.56% was austenitized at 1550° and 1650° F, and cooling transformation diagrams were determined by dilatrometric methods. A 4340 steel was austenitized at 1500° and 1550° F, and was also given stepped austenitizing treatments of 1550° to 1350° F and 1500° to 1350° F. Comparative cooling transformation diagrams are presented together with selected dilatation-temperature curves. With the exception of the 4322 steel, an increase in austenitizing temperature from 1550° to 1650° F led to a displacement of the bainite and ferrite reactions to the left. For the 4340 steel investigated, the stepped austenitizing treatments did not greatly shift the bainite range as represented on the CT diagram, but examination of the temperature-dilatation curves showed an acceleration of the bainite reaction for both the 1500° to 1350° F and 1550° to 1350° F austenitizing treatments. Author

N63-16795 Franklin Inst. Labs. for Research and Development, Philadelphia, Pa.
PREPARATION AND EVALUATION OF HIGH PURITY BERYLLIUM Quarterly Progress Report, Oct. 2, 1962-Jan. 1, 1963
G. E. Spangler, M. Herman, E. J. Arndt, D. B. Hoover, and V. V. Damiano [1963] 18 p
(Contract NOw-62-0536-d)
(Q-B1933-5)

Progress is reported on an investigation to produce high-purity beryllium and to study its deformation and fracture characteristics. Zone refining, single crystal studies, polycrystalline studies, electron transmission microscopy, and self-diffusion in beryllium are also discussed. N.E.A.

N63-16796 Bureau of Mines, Berkeley Thermodynamics Lab., Calif.
HIGH-TEMPERATURE HEAT-CONTENT AND ENTROPY DATA FOR VANADIUM SILICIDE (V_3Si)
Louis B. Pankratz and K. K. Kelley 1963 9 p 6 refs
(BM-RI-6241)

The heat content above 298.15° K was determined for crystalline vanadium silicide of the composition V_3Si. This substance has a minor thermal anomaly (probably a heat-capacity maximum) near 560° K; the extra heat absorption is about 50 cal/mole. The original heat-content data are presented, and smooth values of the heat content and the corresponding entropy increments are listed for the temperature range from 298.15° to 1,500° K. Equations representing the heat-content values and derived heat capacities are also included. Author

N63-16835 Stanford Research Inst., Menlo Park, Calif.
THERMOELECTRIC MATERIALS Bimonthly Progress Report, July 1-Sept. 1, 1962
J. W. Johnson Sept. 14, 1962 6 p
(Contract NObs-77017)
(SRI-21)

The Seebeck coefficient and resistivity of cuprous sulfide–bismuth sulfide, cuprous sulfide–nickel sulfide, and cuprous telluride–lead telluride materials were investigated. Equal mole percentages of each of the pure compounds in each pair were melted together in an evacuated, sealed quartz tube at elevated temperatures and then quenched to prevent segregation of the components during solidification. The n-type liquid resulting when the pulverized cuprous sulfide–bismuth sulfide melt was loaded into the test cell and contacted by graphite electrodes in a helium atmosphere is not attractive as a power generator, but investigation of the liquid could result in an n-type material of interest. The cuprous sulfide–nickel sulfide mixture was melted under one atmosphere of pressure; otherwise, the same method was used. The resulting composition has a low resistivity, and the Seebeck coefficient is too low for use as a power generation material. Similar tests of cuprous telluride–lead telluride showed a p-type composition which is not as promising as cuprous sulfide–cuprous telluride mixtures although it has a lower melting point. M.P.G.

N63-16836 Stanford Research Inst., Menlo Park, Calif.
THERMOELECTRIC MATERIALS Bimonthly Progress Report, Sept. 1-Nov. 1, 1962
J. W. Johnson Nov. 15, 1962 4 p
(Contract NObs-77017)
(SRI-22)

The Seebeck coefficient and resistivity of molten cuprous sulfide under one atmosphere sulfur pressure and of a composition containing 50-50 mol % cuprous sulfide–ferrous sulfide were measured. Although difficulties were experienced with the molten cuprous sulfide measurements, the results indicate that the Seebeck coefficient is considerably less than that observed previously for this composition, so that further study is required to determine its usefulness in power generation applications. The Seebeck coefficient and resistivity values obtained for the cuprous sulfide–ferrous sulfide composition do not make it attractive for power generation applications, but the possibility of a shift from a p-type to an n-type conductor at lower temperatures is of interest in the understanding of such systems. M.P.G.

N63-16838 Merck Sharp and Dohme Research Labs., Rahway, N.J.
STRUCTURAL INVESTIGATIONS IN THERMOELECTRIC MATERIALS Quarterly Report No. 1, Oct. 1-Dec. 31, 1962
P. I. Pollak, J. B. Conn, E. J. Sheehan, and C. J. Barclay [1962] 26 p
(Contract NObs-88112)

Progress in the study to determine whether new and useful thermoelectric materials can be found which are composed of lighter and more abundant elements is reported. Two classes of compounds have been studied to date: the zinc antimonides and the silver selenides. These structures have suggested that if sufficiently large superstructures can be found which are derived from bonding systems with favorable carrier mobility properties, even newer thermoelectric materials may be uncovered. So. attention has been focused on zinc-blende and wurtzite structures. The alloy systems $CuSbSe_2 \cdot (1\text{-}x)\ Cu_3SbSe_4$ and $NAg_2Se \cdot SnSe_2$ have been studied over their complete ranges. D.E.R.

N63-16845 Los Alamos Scientific Lab., N. Mex.
CESIUM WAVE FUNCTIONS
Philip M. Stone May 8, 1963 42 p 1 ref
(Contract W-7405-eng-36)
(LA-2886) OTS: $1.00

Radial wave functions for the ground state and excited states of cesium are presented in tabular form. They are obtained by numerical solution of a one-electron Schrödinger equation with a central, spherically symmetric potential. Author

N63-16878 Naval Research Lab., Washington, D.C.
TENSILE AND IMPACT PROPERTIES OF SOME MARAGING STEEL COMPOSITIONS Interim Report
J. E. Strawley and T. C. Lupton Apr. 23, 1963 8 p 5 refs
(NRL-5916) OTS: $0.50

Laboratory vacuum induction heats of 18%-Ni maraging steels were cast into 25-pound ingots and forged into flat-bar stock. Transverse tensile and Charpy V specimens were obtained from the forged material. One composition contained 8.4% Co, 3.2% Mo, and 0.2% Ti; five others contained 7% or 9% Co and 3.2%, 3.8%, or 5% Mo, but no titanium. Specimens were aged at various temperatures up to 1000° F, and Charpy V and tensile properties were determined at room temperature. Charpy V tests were also conducted at 30° and −20° F. The titanium-containing composition consistently developed considerably better combinations of Charpy V toughness and yield strength than did the others. When aged at 900° F, the yield strength was 190,500 psi, and the Charpy V impact-energy level in the temperature range −20° to 80° F exceeded 50 foot-pounds. Aging at lower temperatures resulted in greater toughness and lower yield strengths. Author

N63-16885 General Dynamics Corp. John Jay Hopkins Lab. for Pure and Applied Science, San Diego, Calif.
ABUNDANCES OF THE FOURTEEN RARE-EARTH ELEMENTS, SCANDIUM, AND YTTRIUM IN THE SOLAR SYSTEM (IN METEORITIC, TERRESTRIAL, AND SOLAR MATTER)
Larry Haskin (Wisconsin U.), R. A. Schmitt, and R. H. Smith Feb. 6, 1963 44 p 79 refs Presented at the Third Rare Earth Conf., Grand Bahama Island, Apr. 21-24, 1963
(NASA Contracts NASr-75 and NASw-579)
(GA-3859; NASA-CR-50119) OTS: $4.60 ph, $1.52 mf

The relative and absolute abundances of the fourteen rare-earth elements, scandium, and yttrium in "primary" meteoritic matter and in the earth are found to be extremely important in order to establish empirical relationships between the abundances, nuclear charge, and mass number of these elements possessing similar chemical properties because of the filled 4-f electron shell, and migrating geochemically and cosmochemically as an "entity." It is found that the relative abundances of the rare earths, scandium, and yttrium remain unchanged over the entire chondritic spectrum, thus supporting the conclusion that the physico-chemical history of the meteorite parent body was not complicated. The rare-earth distribution and scandium fractionation in basaltic achondrites leads to a theory of crystal settling to account for the geochemical reworking. The abundance of the rare-earth elements in terrestrial matter, especially igneous rock, is found to vary, yet shows the earth's matter to be relative to that found in chondritic meteorites while remaining unique by having a crust, mantle, and core. D.E.R.

N63-16889 Boeing Co. Transport Div., Renton, Wash.
INVESTIGATION OF SUSCEPTIBILITY OF HIGH STRENGTH MARTENSITIC STEEL ALLOYS TO STRESS CORROSION Final Report [Mar. 1961-July 1962]
Gary A. Dreyer Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Sept. 1962 220 p 54 refs
(Contract AF 33(616)-7839)
(D6-4093; ASD-TDR-62-876)

The stress-corrosion susceptibility of several high-strength steels has been evaluated by alternate immersion testing in a 3.5-percent salt solution. The variables studied were material, grain direction, heat treatment, stress level, surface preparation, protective coatings, and variations from holes and fasteners. The test materials were 4330M, 4340, 4340M, H-11, AM 350, and AM 355 steels. Notch tensile testing and X-ray diffraction measurements of residual surface stresses were also carried out. Author

N63-16899 Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho
EFFECT OF ALLOYING CONSTITUENTS ON ALUMINUM DISSOLUTION RATES
R. D. Fletcher, M. E. Jacobson and H. R. Beard AEC National Reactor Testing Station, Apr. 15, 1963 32 p 4 refs
(Contract AT(10-1)-205)
(IDO-14606) OTS: $0.75

In studies of the effect of alloying elements on the rate of dissolution of aluminum in mercury-catalyzed nitric acid, it was observed that copper, nickel, and silicon present at concentrations of 1 to 2 percent have significant passivating effects. Iron was slightly catalytic. Passivation due to silicon was partly overcome by contacting the passive alloy with active, high-purity aluminum. Increased catalyst concentration improved the rates when nickel and silicon were present. Neither approach was effective when

copper was the passivating element. Neither approach was effective when copper was the passivating element. For application to nuclear-fuel reprocessing, it is suggested that for minimum reprocessing costs the potentially passive aluminum alloys not be used in fuel elements or that, failing this, electrochemical activation techniques be applied at the processing plant. Author

N63-16901 Ladish Co., Cudahy, Wis.
DEVELOPMENT AND STATISTICAL ANALYSIS EVALUATION OF MELTING AND TRANSVERSE PROPERTIES OF HIGH-STRENGTH (H-11 TYPE) STEEL Interim Engineering Report No. 4, Sept. 23, 1962-Apr. 23, 1963
Joseph C. Truszynski and Jack A. Yoblin Wright-Patterson AFB, Ohio, Met. Process. Branch, May 1963 317 p
(Contract AF 33(600)-38767)
(ASD-TR-7-678(IV))

Four vacuum arc remelt-process variations, commercially available for the production of high-strength steel, were statistically compared in terms of smooth and notch tensile test data developed from transverse and longitudinal specimens removed from 10-inch RCS press-forged billets. Of the four processes, (a) air melt-VAR, (b) air melt-degas-VAR, (c) air melt-double VAR, and (d) vacuum induction melt-VAR, investigated at a 300 Ksi ultimate strength level, the vacuum induction melt-VAR process provided the highest ductility and the most nearly uniform transverse and longitudinal strength and ductility. The air melt-VAR material ranked second in overall property response and uniformity, although significantly lower than that provided by the vacuum induction melt-VAR process. Air melt-degas-VAR and air melt-double VAR processes ranked third and fourth, respectively, but were not significantly different when compared with air melt-VAR property data. Statistical values reported include arithmetic mean, range, standard deviation, coefficient of variation, and standard deviation of the mean. Author

N63-16904 Battelle Memorial Inst., Columbus, Ohio
INVESTIGATION OF THE RELATIONSHIP OF TWINNING TO BRITTLE FRACTURE OF REFRACTORY METALS [Final Report, Nov. 1, 1961 to Dec. 31, 1962]
C. N. Reid, A. Gilbert, and G. T. Hahn Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Apr. 1963 55 p 64 refs
(Contract AF 33(657)-7376)
(ASD-TDR-63-360)

It is concluded that there is good evidence for brittle fracture induced by mechanical twinning in single crystals and polycrystalline Mo-C with grain sizes larger than 0.40 mm. However, there is no evidence for such failures in Mo-C of grain size smaller than 0.25 mm, or in high-purity Cb. The effect of recrystallization texture on twinning is demonstrated, and the orientation dependence of twinning in Cb crystals is reported; a most unusual plastic instability is described in crystals of one orientation. It is shown that twinning in Mo-35Re occurs in bursts, which form in less than 2 μsec; nucleation of twins occurs only at small strains but lateral growth takes place up to at least 12 percent strain. Author

N63-16905 Bendix Corp. Bendix Products Aerospace Div., South Bend, Ind.
DEVELOPMENT OF CHROMIUM COMPOSITE ALLOY WITH HIGH TEMPERATURE OXIDATION AND EROSION RESISTANCE [Final Report, Apr. 1, 1962-Mar. 31, 1963]
James F. Masterson Apr. 1963 150 p 2 refs
(Contract AF 33(657)-8422)
(ASD-TDR-63-297)

The effects of extrusion and rolling variables on the quality and mechanical behavior of a powder metallurgy chromium–magnesium oxide composite have been studied. Hot rolling at 2200° F and finish rolling at 900° F with reductions of 40 to 55 percent provided sound, contamination-free sheet having a ductile-brittle transition temperature of 45° F in the recrystallized condition. Oxidation, erosion, and nitridation behavior were observed to be improved over unalloyed chromium. Preliminary studies have indicated that a strain-aging phenomenon may be responsible for the brittle behavior observed with as-rolled and stress-relieved sheets. Author

N63-16925 General Electric Co. Research Lab., Schenectady, N.Y.
PEST REACTIONS IN INTERMETALLIC COMPOUNDS. I. GRAIN BOUNDARY HARDENING IN NiGa [Final Report, Feb. 1962-Feb. 1963]
A. U. Seybolt and J. H. Westbrook Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Apr. 1963 44 p 19 refs
(Contract AF 33(657)-7980)
(ASD-TDR-63-309, Pt. I)

The phenomenon of grain boundary hardening, recently described by Westbrook and Wood, has been explored in detail for the CsCl structure intermetallic compound NiGa. This compound has a homogeneity range of a few percent, and it was possible to examine the effect of stoichiometry upon the grain boundary hardening due to preferential oxygen diffusion down grain boundaries. While some grain boundary hardening was noticeable just below 50 A/o Ga, the effect was much less pronounced than at 52 A/o Ga. By means of microhardness measurements taken along grain boundaries and also transversely to grain boundaries, it was possible to estimate both bulk diffusion and grain-boundary diffusion rates for oxygen. In the temperature range 600° to 1000° C, D_{oxygen} seemed to be an insensitive function of temperature for both bulk and grain-boundary diffusion. Author

N63-16964 Universal-Cyclops Steel Corp. Refractomet Div., Bridgeville, Pa.
TUNGSTEN SHEET ROLLING PROGRAM PHASE III Third Interim Report, 19 Oct. 1961-19 Jan. 1962
W. J. Schoenfeld Feb. 1962 68 p
(Contract AF 33(600)-41917)
(ASC-TR-7-827(III))

Parameters of investigation include an extensive preliminary rolling study to determine the effects of rolling temperature and reduction on rollability and properties, and the preliminary work on InFab processing. Author

N63-16965 Universal-Cyclops Steel Corp. Refractomet Div., Bridgeville, Pa.
TUNGSTEN SHEET ROLLING PROGRAM—PHASE III Fourth Interim Technical Progress Report, 19 Jan. 1962-19 Apr. 1962
W. J. Schoenfeld May 1962 45 p
(Contract AF 33(600)-41917)
(ASC-TR-7-827(IV))

The completed evaluations from the preliminary rolling investigations are reported. Data are established showing the effects of rolling temperature, reductions, and annealing treatments on the microstructure, tensile properties, and bend transition temperature. The effects of InFab fabrication versus conventional processing are discussed. These investigations have resulted in the following conclusions: (1) Extruded sheet bar shows slightly improved bend transition properties. (2) Reductions of approximately 92% result in the lowest bend transition temperatures. The lowest transition recorded was 200° F. (3) The initial rolling temperature should be no higher than 2300° F, and the final rolling temperature should be 1900° F or lower. (4) Bend transition data on InFab rolled material show no improvement over material rolled in air. (5) No improvement in transverse-bend transition temperature was noted for InFab cross-rolled material. Author

N63-16966 Universal-Cyclops Steel Corp. Refractomet Div., Bridgeville, Pa.
TUNGSTEN SHEET ROLLING PROGRAM—PHASE III FINAL REPORT Fifth Interim Report, 19 Apr. 1962-1 Sept. 1962
W. J. Schoenfeld Nov. 1962 61 p 1 ref
(Contract AF 33(600)-41917)
(ASC-TR-7-827(V))

The effect of various processing parameters on workability and final properties is documented. Significant conclusions from the Phase III work are as follows: (1) Extrusion to rounds or to rectangular cross-section sheet bar can be accomplished equally well. (2) Initial rolling of extruded or extruded and forged product can be and is best accomplished in the temperature range of 2300° F. (3) In order to achieve the lowest ductile-brittle transition, final rolling temperatures should not exceed 1550° F. (4) Cross rolling improves both the longitudinal and the transverse bend and tensile properties. Author

N63-16967 Universal-Cyclops Steel Corp. Refractomet Div., Bridgeville, Pa.
TUNGSTEN SHEET ROLLING PROGRAM Sixth Interim Report, 1 Sept. 1962-31 Jan. 1963
W. J. Schoenfeld Feb. 1963 31 p
(Contract AF 33(600)-41917)
(ASC-TR-7-827(VI))

Melting and extrusion was scaled up to meet the sheet-size requirements of this phase. Specifically, four 8-in. ingots were melted, conditioned to 6-in. extrusion billets. Two were extruded to 3-in. round for subsequent forging to sheet bar, and the remaining two were extruded direct to 1.75-in. × 4-in. sheet bar. All extrusions were evaluated, and the 3-in. rounds press forged to 2-in.-thick sheet bar. The first rolling operation was accomplished successfully on both press-forged and direct-extruded rounds. Author

N63-16968 Universal-Cyclops Steel Corp. Refractomet Div., Bridgeville, Pa.
TUNGSTEN SHEET ROLLING PROGRAM Seventh Interim Report, 1 Feb. 1963-30 Apr. 1963
W. J. Schoenfeld May 1963 44 p
(Contract AF 33(600)-41917)
(ASC-TR-7-827(VII))

Two sheets of .060-in.-, two of .040-in.-, and five of .020-in.-gage sheets were rolled to a nominal 36 in. wide by 36 in. long. Cracking occurred on several pieces during initial rolling; this was attributed to excessive reduction per pass. On subsequent rolling, this problem was minimized. Cracking that occurred on the thinner gages was attributed to handling. This problem has not been resolved. The bend properties of the .060-in. material were consistent with those previously established. Tensile properties below 200° F have not been established due to premature failure of the specimen; however, the properties above this temperature have been established and are within the desired variation limits. Gage and flatness were also within the desired limits on the 0.60-in. material. Author

N63-16974 General Electric Co. Research Lab., Schenectady, N.Y.
CYCLIC-STRAIN INDUCED OXIDATION OF HIGH-TEMPERATURE ALLOYS
L. F. Coffin, Jr. Dec. 1962 14 p 4 refs
(Rept. 62-RL-3190-M)

This report documents the observation of highly localized regions of surface oxidation in certain high-temperature alloys, when subjected to cyclic plastic strain at elevated temperature. An explanation of the observed effects is given, based on localized and reversed grain boundary deformation which leads to repeated rupture of the protective oxide film and accelerated oxidation in the region of deformation. These regions serve as nuclei for initiating fatigue cracks. Author

19 MATERIALS, NON-METALLIC

Includes: mechanical and physical properties of non-metals (e.g., plastics).

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-16420 Deutsche Forschungsanstalt für Luft- und Raumfahrt. Inst. fur Flugzeugbau, Brunswick (W. Germany)
BEHAVIOR OF FIBER GLASS REINFORCED SYNTHETIC RESINS UNDER TORSIONAL STRESS PERPENDICULAR TO THE LAMINAR PLANE (FESTIGKEITSVERHALTEN VON KUNSTSTOFFEN MIT GLASGEWEBEVERSTARKUNGEN BEI BELASTUNG SENKRECHT ZUR LAGENBENE)
G. Niederstadt 1963 37 p 3 refs In GERMAN
(DFL-204) Available from DFL: DM 12

This report describes a new method for estimating the degree of adhesion between glass fibers and resins. Laminates were produced from different types of spun glass fabrics and different types of resins. The laminates were placed under torsional stress perpendicular to the laminar planes. The degree of adhesion was evaluated and this evaluation provided an index for evaluating the cementing process as well as the efficiency of the adhesive.
Transl. by I.v.L.

N63-16476 Feltman Research Labs., Picatinny Arsenal, Dover, N.J.
WAYS OF OBTAINING SUPER-STRONG UNBREAKABLE GLASS
M. A. Bexborodov and A. M. Kripskiy Mar. 1962 15 p Transl. into English by JPRS from Vestnik Akad. Nauk SSSR (Moscow), No. 1, 1961 p 65–69
(FRL-TN-101)

The coefficient of brittleness (the reciprocal of maximum relative deformation) is given for glass and several other materials. The elimination of microdefects may increase tensile strength a hundred times. Some ways to remove defects are: pickling in HF, to remove surface cracks; heating in a vacuum at high temperature, to remove gases; cooling under great pressure, to prevent microcracks; and gamma irradiation during melting and cooling, to prevent crystallization. Tensile strength may be increased, too, by forced polymerization induced by powerful sonic or ultrasonic waves. Author

N63-16484 Atlantic Research Corp., Alexandria, Va.
STUDY OF REACTIONS BETWEEN PLASTIC COMPOSITE MATERIALS AND PROPELLANT EXHAUST PRODUCTS Third Quarterly Progress Report, Dec. 1, 1962 to Mar. 1, 1963
J. Batchelor and W. West Mar. 1963 25 p
(Contract AF 33(657)-8475)

The results of the theoretical analyses of the equilibria in the chemical-reaction systems involving the constituents of ablative plastic composites and gases, found in propellant exhaust products, were reported previously. Based on these predictions, experimental reaction studies were carried out during the current period. Using variable arc-power input (about 9 to 20 kw) to achieve specimen temperatures ranging from about 2400° to 3600° F, the loss

rates of several composite materials, typical of the most important basic formulations, were measured in CO_2, H_2O, and N_2 environments in the arc-image unit. Preliminary plasma-torch tests showed similar behavior patterns with higher weight-loss rates in comparison to the arc-image tests. Author

N63-16553 Princeton U. Frick Chemical Lab., N.J.
VISCOELASTIC PROPERTIES OF A SIMPLE ORGANIC GLASS
A. V. Tobolsky and R. B. Taylor May 1963 19 p 8 refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-59)

The shear compliance of a three-dimensional glass-forming substance, Galex, composed largely of dehydroabietic acid has been studied as a function of time and temperature by a ball indentation method, and the results are expressed in terms of a master curve of shear compliance against time at 15° C. This curve has been analyzed to separate the various components of the compliance, and it is found that a glassy compliance, a single retardation time, and a steady-flow shear viscosity are sufficient to describe the viscoelastic behavior of the compliance over the entire time scale. The glass transition temperature has been determined by volume temperature measurements and found to be 7° C. The variation of the shear viscosity and the viscoelastic shift factors as a function of temperature are also discussed. Author

N63-16579 Carborundum Co., Niagara Falls, N.Y.
A STUDY OF FUNDAMENTAL MECHANICAL PROPERTIES OF CERAMIC SINGLE CRYSTALS Second Bi-Monthly Progress Report, Mar. 15 through May 14, 1963
P. T. B. Shaffer and H. D. Batha May 22, 1963 5 p
(Contract N600 (19)-59749)

Additional data on strength and elastic properties of boron-doped silicon carbide crystals have been obtained on thin (10μ to 70μ) crystals. Analyses are being made to determine the specific effect of impurities on strength. Author

N63-16617 Quartermaster Research and Engineering Center, Natick, Mass.
TENSILE IMPACT ON RUBBER AND NYLON
Malcolm N. Pilsworth, Jr. *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 328-340 4 refs (See N63-16603 14-34)

The response of rubber and nylon to tensile impact was investigated at rates in which the ratio of the impact velocity to the velocity of propagation in the material is an appreciable fraction of the breaking strain. Several methods of observing the response were used, including a photographic technique with a high-speed stroboscope. Dynamic stress-strain curves were deduced from the observed responses, and the wave pattern of the response was constructed according to the von Kármán method. The constructed response was found to always have more distinct waves and sharper wave fronts than the observed response, which indicated that an appreciable fraction of the relaxation time spectrum was included in the range between the total time of the test (a few milliseconds) and the time required for a constructed wave front to pass a point in the sample (several hundred microseconds). This delayed response was expressed as a creep function and an analysis was made by adding the increase in strain due to the creep function to the strain constructed from a stress-strain curve. The resulting strain wave pattern for rubber agreed with the observed pattern much better than the strain wave pattern constructed from a stress-strain curve alone. The pictures obtained of the nylon yarn were not good enough for a similar detailed analysis, but a stress-strain curve was determined from the motion of the tail mass and the stress at the fixed end determined as a function of time. M.P.G.

N63-16786 Avco Corp. Research and Advanced Development Div., Wilmington, Mass.
INVESTIGATION OF BEHAVIOR OF NEW PLASTIC AND COMPOSITE MATERIALS Quarterly Progress Report No. 3, Jan. 15–Apr. 30, 1963
R. R. John May 15, 1963 4 p
(Contract AF 33(657)-8892)

Progress is reported as follows: (1) Twenty-six Hughes samples have been tested. (2) Fifteen new Hughes research samples were received on April 15, 1963, for screening in environment No. IV (heat flux, 900 BTU/ft^2 sec; air enthalpy, 8500 BTU/lb). (3) Fifty-six Chance Vought samples have been received for material characterization tests in environment numbers I, II, and III. Eighteen of the Chance Vought samples have been instrumented with thermocouples. The samples (i.e., A-5-Zr-1, 5, and 6) containing zirconia fibers chipped and spalled during the sample machining process. Sample holders have been prepared for the Chance Vought samples. Author

N63-16883 Mellon Inst., Pittsburgh, Pa.
TEKTITE
Alvin J. Cohen Repr. from McGraw-Hill Yearbook of Sci. and Tech., 1962 1 p 6 refs
(NASA Contract NsG-57-60)

Various types of tektites, their composition, ages, occurrences, and origin are discussed. Recent dating by the potassium-argon method indicates that tektites are of at least three different ages: 15,000,000 years old, 33,000,000 years old, and 600,000 years old. One school of thought feels that tektites can be produced only by asteroid impaction on the moon and another that they can be produced only by asteroid impaction on the earth. J.A.J.

20 MATHEMATICS

Includes: calculation methods and theory; computers; data processing; and numerical analysis.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; and 22 Navigation and Guidance.

N63-16351 Boeing Scientific Research Labs. Mathematics Research Lab., Seattle, Wash.
SINGULAR PERTURBATIONS OF DIFFERENTIAL EQUATIONS, II
Bernard Friedman (Calif. U.) Aug. 1962 50 p 2 refs
(DI-82-0208; AD-291446)

The method of perturbation—one method of approximating the solution of applied differential equations by replacing the original equation by a related one which can be solved and considering the difference between the two solutions as a perturbation of the solvable equation—is explained for the case of the equation containing a small parameter, ϵ (epsilon). The solutions are written as a power series in ϵ, which is substituted in the differential equation, equating the corresponding powers of ϵ. The resulting expansion equations are solvable if the expansion procedure works. Then the cases where the expansion procedure fails are investigated in an exploratory fashion to find that expansion fails because the limit of the original differential equation as ϵ goes to zero is a differential equation of a lower order. D.E.R.

N63-16360 Monsanto Research Corp., Dayton, Ohio
FLAME SPEED DATA REDUCTION AND CORRELATION USING A DIGITAL COMPUTER [Final Report]
G. H. Ringrose, D. R. Miller, A. C. Pauls, and G. B. Skinner Wright-Patterson AFB, Ohio, Flight Accessories Lab., Feb. 1963 95 p 6 refs
(Contract AF 33(657-7617)
(ASD-TDR-63-182)

Two digital-computer routines were developed to process flame-speed data resulting from the burning of compounds in air and oxygen, and to correlate particular structural configuration with flame speed. In both routines, a high degree of flexibility has been incorporated to assure efficient utilization under several forseeable circumstances. The first routine, FSC, processes the raw experimental data to obtain flame speeds, equivalence ratios, and the equivalence ratio at the maximum flame speed. This information is stored on a master magnetic tape for subsequent calculations. The second routine, FSR, permits selection of specific data groups from the master tape for analysis. A linear model was chosen for the correlation. Author

N63-16361 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
THE APPLICATION OF FRIEDRICHS TECHNIQUE TO THE SHIP PROGRAM
Solomon Ciolkowski May 1963 31 p 1 ref
(Contract Nonr-3616(00))
(RE-164)

This report describes a perturbation scheme for the solution of the ship problem. An integral equation is obtained; the solution of this equation determines the velocity potential as well as the free surface of the fluid associated with the flow around a ship hull. The perturbation is carried out to terms of second-order in the perturbation parameter. The results are then applied to the case of a two-hulled ship. Author

N63-16368 Advisory Group for Aeronautical Research and Development, Paris (France)
A TABLE OF EQUIVALENTS OF ACCELERATION TERMINOLOGIES (TABLEAU D'EQUIVALENCES DE LA TERMINOLOGIE DE L'ACCELERATION)
C. F. Gell et al (Acceleration Com., Aero Space Med. Panel) 1962 11 p In ENGLISH and FRENCH
(*Its* Specification 3)

This specification comprises a table of equivalents for acceleration terminologies, prepared from data provided by NATO aerospace medical sources and recommended for general international use. Two basic groups of terminologies are included: (1) the two acceleration terms commonly used in aeronautics with reference to the direction of acceleration of a mass; and (2) terms referring to the inertial reaction of the tissues and fluids of the mammalian body considered intact, in response to accelerations applied to the whole body. Author

N63-16385 Atomic Energy Commission. New York Operations Office. Health and Safety Lab., N.Y.
A COMPUTER PROGRAM FOR CALCULATING NEUTRON INTERACTION BETWEEN CYLINDRICAL STORAGE CONTAINERS
Stephen Lanes and Theodore Rosenberg Washington, AEC Div. of Tech. Information, Feb. 1963 38 p 8 refs
(HASL-126) OTS: $1.00

A computer method and program are presented for the calculation of neutron interaction between cylindrical storage containers holding fissionable material. The method is applicable to container arrays of either square or rectangular pitch, up to and including a maximum array size of 20 X 20 units. The program uses the FORTRAN II language, and was compiled on the IBM-1620 computer. A description of the computer analysis of this interaction problem, and an example of its application to the nuclear safety review of proposed uranium storage systems, are presented. The neutron interaction, combined with the criticality characteristics of the individual containers, determines the safety of the array. Author

N63-16390 Midwest Research Inst. Mathematics and Physics Div., Kansas City, Mo.
EXPANSIONS OF SPHEROIDAL WAVE FUNCTIONS Technical Report
Yudell L. Luke June 1, 1962 16 p 5 refs
(Contract Nonr-2638(00)(X))

Abramowitz developed a solution to the equation

$$\frac{d}{d\eta}\left[(1-\eta^2)\frac{dS_{mn}}{d\eta}\right]+\left[\lambda_{mn}(c)-c^2\eta^2-\frac{m^2}{1-\eta^2}\right]S_{mn}=0. \quad (1)$$

The values $\lambda_{mn}(c)\equiv\lambda_{mn}$ for which the solutions of (1) are finite at $\eta = \pm 1$ are the characteristic or eigenvalues of (1), and the S_{mn} are the associated characteristic or eigenfunctions of order m and degree n. This solution was developed for the following cases: (I) m is larger with respect to c; and (II) m and c are both large. In the present paper, additional terms are derived for the Case II situation and it is shown that Case I is essentially a specialization of Case II. Further, it is shown that the Case II expansion for λ_{mn} is uniform in the sense that if c is small with respect to m, the Case II expansion and the usual convergent expansion for small c effectively coalesce; and if c is large with respect to m, the Case II expansion and the asymptotic expansion of $\lambda_{mn}(c)$ effectively coalesce. Thus, the development of more terms for the Case II expansion should be most helpful as the series is useful for all $c, 0 \leq c \leq \infty$, and m a positive integer provided (n-m) is moderate. I.v.L.

N63-16395 Massachusetts Inst. of Tech. Electronic Systems Lab., Cambridge
APPLICATION STUDIES OF COMBINED ANALOG-DIGITAL COMPUTATION TECHNIQUES Final Report
Frank B. Hills Feb. 1963 81 p 53 refs
(Contract AF 19(604)-6654)
(ESL-FR-165; AFCRL-63-72)

The concept of pulsed-analog computation in which high-speed, time-shared analog computing elements operate under the control of a digital computer is described. The design of a demonstration pulsed-analog computer developed at the Electronics Systems Laboratory is presented as well as a brief description of some problems solved by the computer. The applicability of combined analog-digital computation techniques to a number of computational tasks is discussed. The computation tasks studied were those for which it was felt that combined analog-digital techniques would provide some advantages over purely analog or purely digital techniques. Author

N63-16401 General Precision, Inc. Link Div., Binghamton, N.Y.
UNIVERSAL PRINT READER Final Report
A. K. Dietrich, R. B. Greenly, K. W. Jenkner, R. E. Kittredge, J. F. Kripl, F. P. Lewandowski, K. K. Maass, J. W. Meyer, and E. A. Mikolas Mar. 1963 99 p
(Contract AF 30(602)-2642)
(Rept. 3.469; RADC-TDR-63-181)

The objective of this program was to determine the potential capabilities of the Link Reading Technique toward fulfilling the requirements of a reading machine which could be appropriately

referred to as "A Universal Print Reader." Emphasis was placed on development of paper-handling capability as well as multifont recognition, since commercially available equipment in both areas falls far short of "universal" status. Results indicated that reliable multifont recognition can be realized and compatible paper-handling mechanisms can be made which are tolerant of a reasonable amount of input document degradation such as is common with field-prepared documents. This report contains a detailed description of the operating principles of a complete Link page-reading system, along with a number of techniques for extending the performance of this machine. Author

N63-16423 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MARINER II: PRELIMINARY REPORTS ON MEASUREMENTS OF VENUS
L. A. Frank (Iowa State U.) et al Repr. from Science, v. 139, no. 3559, Mar. 8, 1963 p 905–910 refs
(NASA Contract NAS7-100)
(JPL-TR-32-429)

There was a complete absence of charged particles associated with the planet Venus at radial distances as small as 41,000 Km on the sunward side of the planet. This result is taken to mean that the magnetosphere of Venus, if any, does not extend to that great a distance. The most plausible interpretation is that $(M_V/M_E) \leq 0.18$, where M_V and M_E are the dipole magnetic moments of Venus and Earth, respectively. The results are consistent with $M_V/M_E = 0$. Certain qualifications prevent this interpretation from being a definitive one. Author

N63-16439 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPUTER PROGRAM FOR REDUCTION OF NEUTRON ACTIVATION FOIL DATA
L. K. Zoller May 16, 1962 134 p
(NASA TM X-50016; MTP-P&VE-M-62-9) OTS: $10.50 ph, $4.22 mf

In order to provide a rapid, consistent, and accurate means for reducing and organizing "raw" foil counting data from neutron activation foils, a computer program has been written for utilization on the IBM-704 and 7090 digital computers. This computer program features flexibility to provide for nearly all commonly encountered data-acquisition and data-reduction techniques. Further, it is designed to provide the maximum information obtainable from the input data in the event that a program "stop" is encountered. Author

N63-16452 Bettis Atomic Power Lab., Westinghouse Electric Corp., Pittsburgh, Pa.
A FORTRAN PROGRAM TO SOLVE THE P-3 GAMMA RAY EQUATIONS IN SLAB GEOMETRY
W. D. Lanning Apr. 1963 35 p 14 refs
(Contract AT(11-1)GEN-14)
(WAPD-TM-356) OTS: $1.00

A program has been developed to solve the P-3 gamma-ray equations in slab geometry. The formulation which is utilized to compute the spatial distribution of the gamma energy flux is described. The program was written specifically as a shield design tool for performing gamma-energy-deposition calculations and for other potential design applications. Author

N63-16473 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE MINIMAL REALIZATION OF ALL LINEARLY SEPARABLE SETS OF n DIMENSIONS Technical Report: Applied Mathematics
E. S. A. Whitmore Mar. 1962 35 p refs

This paper gives a systematic way to find all the canonical linearly separable sets of n variables and an algorithm which may be used: (1) to determine whether or not a given set is linearly separable or whether two or more given linearly separable sets can be realized by the same weights and (2) to find the minimal integer weights and thresholds required for such a realization. The principal advantage to this algorithm, applied by Black, lies in the systematic elimination of inequalities that are redundant. D.E.R.

N63-16507 California U., Berkeley. Lawrence Radiation Lab.
CONDITIONS FOR THE DISCRETENESS OF THE SPECTRUM OF SINGULAR ELLIPTIC OPERATORS
Harold Hanerfeld Jan. 1963 50 p 12 refs
(Contract W-7405-eng-48)
(UCRL-10744) OTS: $1.25

The Dirichlet problem for singular second-order elliptic operators is discussed in the light of formulating and proving sufficient conditions for such operators to have a discrete spectrum. I.v.L.

N63-16528 Wisconsin U., Madison
SOME EXTREMAL QUESTIONS FOR SIMPLICIAL COMPLEXES III. PROBLEMS OF THE GEOMETRY AND ANALYSIS OF THE HIGHER EUCLIDEAN SPACES Technical Summary Report
L. C. Young May 1962 32 p 15 refs
(Contract DA-11-022-ORD-2059)
(MRC-320)

Various aspects of a single problem of an extremal character connected with the notion of convexity are discussed. Further problems, which are background in nature, are also discussed. These problems range from rigid statistics to line geometry and to the rewriting of the whole differential calculus with Kneser partial derivatives. I.v.L.

N63-16529 Wisconsin U., Madison
SOME EXTREMAL QUESTIONS FOR SIMPLICIAL COMPLEXES IV. THE ALGEBRAIC AND THE GEOMETRIC RESULTANT, AN APPLICATION OF VARIATIONAL METHODS Technical Summary Report
W. H. Fleming and L. C. Young May 1962 20 p 14 refs
(Contract DA-11-022-ORD-2059)
(MRC-322)

The object of this paper is to prove the theorem—a system of K-vectors has an algebraic resultant j, if and only if it has the geometric resultant j—i.e., to establish for a system of multivectors, or in particular for a system of forces acting on a three-dimensional body, the identity of the algebraic and the geometric resultant, whenever one of them exists. The extremal nature of this theorem, already brought out by its role in the convexity theorem—in order that the k-integrand F be convex at j, it is necessary and sufficient that, for each K-simplex Δ associated with j, the integral of F over Δ be the minimum value of the expression $\frac{1}{m}\int_{\Pi} F$, for polytopes Π whose boundary is m times that of Δ—will be shown again by its proof, which uses the techniques of modern variational theory. I.v.L.

N63-16541 Wisconsin U. Theoretical Chemistry Inst., Madison
DIRECT PRODUCT REPRESENTATION OF WAVE FUNCTIONS
Ernest R. Davidson and Leon L. Jones June 7, 1962 13 p 3 refs
(Contract NOrd-15884)
(CF-2986, Ser. 3)

A direct product representation for N particle wave functions is introduced through a coefficient matrix C_p. Density matrices and the natural p-states are redefined in terms of C_p. The projection

operator formalism is used to derive an eigenvalue equation for the natural p-states. A generalization of the exact self-consistent field equations is derived from the concept of natural group functions. Author

N63-16543 Oak Ridge National Lab., Tenn.
A COMPARISON OF SEVERAL METHODS FOR INVERTING LARGE SYMMETRIC POSITIVE DEFINITE MATRICES
M. H. Lietzke, R. W. Stoughton, and Marjorie P. Lietzke May 23, 1963 36 p 7 refs
(Contract W-7405-eng-26)
(ORNL-3430)

Four methods for inverting large, symmetric, positive, definite matrices have been compared. These are the Gauss–Jordan, Choleski, congruent transformation, and rank annihilation methods. An attempt has been made to consider the effects of both condition and order of the matrix to be inverted on the closeness of the computed inverse to the exact inverse. Each method was programed in FORTRAN using only single precision arithmetic. The error indicators were then computed, using double precision arithmetic so that the latter calculation was not a limiting factor. It was found that any one of the methods is satisfactory for a well-conditioned least-squares matrix of order 10 to 30. However, when the matrix becomes ill-conditioned, then the Gauss–Jordan method appears to be clearly superior (at least for the matrices studied). Algorithms and FORTRAN subroutines for each method are presented in the appendices. Author

N63-16552 Wisconsin U., Madison
SOLUTION OF AN INTEGRAL EQUATION OF THE THIRD KIND BY SUCCESSIVE APPROXIMATIONS Technical Summary Report
P. M. Anselone, H. F. Bueckner, and D. Greenspan May 1963 31 p 7 refs
(Contract DA-11-022-ORD-2059)
(MRC-345)

The integral equation

$$tP(t) = \mu \int_0^t (t-s)^{-\lambda} P(s)\, ds, 0 \leqq t < \infty,$$

where $\mu > 0$ and $0 < \lambda < 1$, has a unique solution P(t) which satisfies appropriate auxiliary conditions. Successive approximations to P(t) are derived by means of a trapezoidal numerical-integration scheme. They converge uniformly to P(t) for $0 \leqq t < \infty$. Other approximation methods are described and numerical examples are given. Applicability of the methods to more general integral equations is indicated. Author

N63-16561 California U., Berkeley. Lawrence Radiation Lab.
LINEAR COMPUTATION OF FUNCTION APPROXIMATION WITH APPLICATION TO FITTING AND EDITING TWO-DIMENSIONAL DATA
Jonathan D. Young Mar. 26, 1963 10 p 1 ref
(Contract W-7405-eng-48)
(UCRL-10734) OTS: $0.50

Linear computation of level functional approximations for a discrete function is applied to fitting and editing two-dimensional data, with particular emphasis on the case in which the approximating function involves two fewer parameters than the number of points. Author

N63-16580 European Atomic Energy Community, Brussels (Belgium)
FAST DETERMINATION OF THE INTENSITY RATIO OF SPECTRAL LINES BY THE SELF-CALIBRATING METHODS (DÉTERMINATION RAPIDE DU RAPPORT D'INTENSITÉ DES RAIES SPECTRALES PAR LA METHODE D'AUTO-CALIBRATION)
G. Rossi Joint Nuclear Res. Center, Ispra Establishment (Italy), Chemistry Service, Apr. 1963 21 p 12 refs In FRENCH; ENGLISH abstract
(EUR-202.f) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86: 40 BF

The possibility of applying the self-calibrating method to routine analysis was studied. Intensity ratios of the spectral lines, with the background correction, may be calculated with high accuracy without tracing plate calibration curves. On this basis, a special slide rule was sealized for intensity ratios calculations. Author

N63-16589 Wisconsin U., Madison
EXTINCTION PROBABILITIES FOR AGE AND POSITION-DEPENDENT BRANCHING PROCESSES Technical Summary Report
Howard E. Conner Mar. 1963 26 p 8 refs
(Contract DA-11-022-ORD-2059)
(MRC-390)

A model for the population transition probabilities for a branching process composed of particles diffusing in a finite interval is studied. The model is in general non-Markovian since we assume the branching transformation probabilities for a particle depend on its age and position. The process is described by the random number $N_t(x)$ of particles in the interval I at time t that are generated by a single particle initially at the point x in I. By considering $N_t(x)$ as a regenerative process with respect to the random age and position of the initial particle when it is transformed, we develop a functional equation for the generating function for $N_t(x)$. This functional equation is the basis for our study of the population probabilities $P(N_t(x) = n)$, $n = 0, 1, 2, \ldots$, as function of x in I and t in $(0, \infty)$. The principal result concerns the extension to our model of the fundamental result on the probability for ultimate extinction in a Galton–Watson branching process. Letting $f_0(x)$ be the probability for ultimate extinction in a process generated by a particle initially at x, a necessary and sufficient condition for $f_0(x) = 1$ is given. A characterization is given of $f_0(x)$, x in I, as the minimal positive solution of a functional equation which is asymptotically related to the basic equation. Author

N63-16590 Wisconsin U., Madison
APPLICATIONS OF THE FACTORIAL CALCULUS TO GENERAL UNEQUAL NUMBERS ANALYSES Technical Summary Report
W. T. Federer and M. Zelen Apr. 1963 16 p 5 refs
(Contract DA-11-022-ORD-2059)
(MRC-393)

The necessary elements of the calculus for factorial as developed by Kurkjian and Zelen are described, modified where necessary, and applied to the analysis of unbalanced n-way classifications with fixed effects. Estimators for all main effect and interaction effects parameters are obtained along with the associated variances. The sums of squares for each effect eliminating all other effects is presented in a form suitable for direct computation. This form results in considerable computational saving over the method of fitting constants used in general regression theory. The results are applied to the particular case of proportional frequencies in the subclasses. Author

N63-16591 Wisconsin U., Madison
EXTREMAL SPECTRAL FUNCTIONS OF A SYMMETRIC OPERATOR Technical Summary Report
Richard C. Gilbert Apr. 1963 27 p 5 refs
(Contract DA-11-022-ORD-2059)
(MRC-397)

It is known that the finite dimensional extensions of a symmetric operator define extremal spectral functions of the operator. Finite dimensional extensions exist, however, only for symmetric operators with equal deficiency indices. In this report, it is shown that self-adjoint extensions defined by the addition of maximal symmetric operators determine extremal spectral functions for a symmetric operator with unequal deficiency indices. Author

N63-16592 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
THE IDENTIFICATION OF OVERDAMPED PROCESSES IN THE TIME-DOMAIN
Jerry M. Mendel Apr. 19, 1963 151 p 34 refs
(Grant AF-AFOSR-62-280)
(PIBMRI-1131-63)

The problem of characterizing overdamped systems, from data in the time domain, by means of exponential functions is studied. Particular attention is given to: (1) the choice of a suitable error criterion based upon performance measures the approximate system is to meet, (2) the choice of weighting functions and their effect on the approximations, and (3) the extension of the orthonormal exponential approximations of Kautz and Huggins to approximations of any asymptotic-order in the s-domain. Author

N63-16594 Wisconsin U., Madison
POWER SERIES WHOSE SECTIONS HAVE ZEROS OF LARGE MODULUS Technical Summary Report
J. D. Buckholtz Apr. 1963 23 p 11 refs
(Contract DA-11-022-ORD-2059)
(MRC-398)

Given a power series, $\Sigma a_p z^p$, let r_n denote the smallest modulus of a zero of $s_n(z) = \sum_{p=0}^{n} a_p z^p$, n = 1, 2, 3, ... Upper and lower estimates for r_n are obtained under the hypothesis that $\Sigma a_p z^p$ is the power series for an entire function without zeros. For certain classes of such series, asymptotic formulas for r_n are derived. Characterizations (in terms of r_n) are obtained for entire functions of the forms exp {P(z)} and exp {g(z)}, where P(z) is a polynomial and g(z) is an entire function of finite order. Author

N63-16666 Wisconsin U., Madison
AN ALGEBRAIC PROBLEM IN CONTROL THEORY Technical Summary Report
Arthur Wouk Apr. 1963 33 p 9 refs
(Contract DA-11-022-ORD-2059)
(MRC-392)

The indeterminacy of the reduction of an arbitrary matrix to Jordan normal form is used to study the Luré canonical equations for a linear control system with a single nonlinear actuator. The Luré transformation is shown to be essentially a scaling operation applied to an arbitrary transformation which reduces the system to Jordan canonical form. In the case of nonlinear elementary divisors, the proper choice of canonical variables simplifies the calculation of stability conditions. Author

N63-16710 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPUTER EVALUATION OF RAWINSONDE DATA FOR SPACE VEHICLE APPLICATIONS
Halsey B. Chenoweth and Bettye Anne Busbee Washington, NASA, May 16, 1962 28 p 10 refs
(NASA TM X-50020; MTP-AERO-62-41) OTS: $2.60 ph, $1.04 mf

Procedures for computing certain thermodynamic and kinematic properties of the atmosphere from radiosonde observations have been developed and are outlined in a variety of sources. The purpose of this report is to: (1) select certain of these procedures, (2) discuss the theory involved in method choices of handling raw data, (3) compute the necessary functions for smoothing and presenting the data, and (4) present a program for machine computation of the atmospheric parameters. The body of the report deals with evaluation of atmospheric parameters through the altitude range for which radiosonde-measured values are available and reliable. The procedure for extrapolating parameter values at higher (30 km) altitudes is presented as an appendix. The technique outlined for rawinsonde-data evaluation was developed to provide a scheme for direct interjection into MSFC flight-evaluation programs. Author

N63-16716 Aberdeen Proving Ground. Ballistic Research Labs., Md.
THE PERFORMANCE OF A SKYSCREEN SYSTEM USING AN ELECTRICAL ANALOGUE COMPUTER
Donald F. Menne Jan. 1963 34 p 7 refs
(BRL-TN-149)

The performance of a skyscreen system using an electrical analog computer was demonstrated in a series of laboratory tests. The computer was developed at the Franklin Institute Laboratories. Inputs for the computer are continuous analog presentations of unrestricted azimuth and elevations angles to the target, and the output is the positioning of a skyscreen aperture at the focal plane of the camera. The criterion for evaluating the performance of the system was the difference between the observed position of the skyscreen aperture and its corresponding theoretical position for selected inputs. The mean of the differences for all tests was 0.38 mm. Test results indicate the acceptability of an electrical analog computer as a component of a skyscreen system. Author

N63-16717 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
S-51 REAL TIME DATA REDUCTION SYSTEM
Harold H. Levy, Alan M. Demmerle, and Robert L. Feinberg Sept. 1962 63 p
(NASA TM X-50025; NASA-X-561-62-158) OTS: $6.60 ph, $2.09 mf

The S-51 real-time data reduction system decommutates and recognizes an analog and digital pulsed frequency modulated telemetry format of 16 channels per frame at a rate of 50 channels per second. For the digital input of three bits per channel, the system recognizes eight discrete frequency bands between 5Kc and 15Kc and converts these frequencies to a decimal number and prints the number and its identification on a paper tape. For the analog input, the system prints the 10-period average. This report contains a description of the telemetry format, the system components, the type of logic used, and the operation of the system. Author

N63-16723 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ROOT-MEAN-SQUARE ERROR ANALYSIS FOR EQUATIONS IN RAWINSONDE EVALUATION PROGRAM
Bettye Anne Case Washington, NASA, Nov. 13, 1962 42 p 18 refs
(NASA TM X-50000; MTP-AERO-62-82) OTS: $4.60 ph, $1.46 mf

This paper assumes rms errors for each of the five basic rawinsonde-measured atmospheric parameters, determined on the basis of available previous studies. The manner in which these errors propagate errors in the evaluation equations is examined. A computer procedure is used to approximate the partial derivatives necessary, utilizing the original evaluation program. Selected

thermodynamic and wind quantities computed from rawinsondes released near launch time for Saturn SA-1 and Saturn SA-2 are presented graphically with their corresponding rms errors, and a brief discussion is given of the variation between angle-of-attack and rawinsonde-measured wind evaluations. Within the limits of the accuracy of the assumed errors in the basic variables and the necessity for computer approximations, rms-error values computed by the procedures in this paper give an indication of the nature and magnitude of errors in rawinsonde evaluations. Author

N63-16730 Virginia Polytechnic Inst., Blacksburg
TECHNIQUES FOR EXAMINING THE STATISTICAL AND POWER SPECTRAL PROPERTIES OF RANDOM TIME HISTORIES
Herbert A. Leybold (M.S. Thesis) May 1963 69 p 29 refs

A technique for digitally generating random time histories having arbitrarily shaped power spectra is presented. Four random time histories having significantly different statistical and power spectral properties have been generated and analyzed to determine their mean and amplitude distributions. It was found that the distribution of means could be approximated by a normal distribution and that the distribution of amplitudes could be approximated by the sum of a Rayleigh distribution and a normal distribution. An attempt was made to relate the coefficients of the equations used to represent the distributions of means and amplitudes to the power spectral properties of the generated time histories. It was found that two of the coefficients could be related to the power spectral properties of the time histories. The remaining two coefficients were empirically determined, since no apparent relationship was found between these coefficients and the power spectral properties of the generated random time histories. A discussion of the applicability of results for estimating fatigue life under randomly varying loads or stresses is presented. Author

N63-16772 Air Force Packaging Lab., Brookley AFB, La.
USE OF THE ANALOG COMPUTER TO STUDY CUSHION CHARACTERISTICS AND PACKAGE DESIGN
W. E. Schmidt, III *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 257–264 14 refs This paper was not presented at Symp. (See N63-16750 14-01)

This paper describes the force analyzer and the analog computer which have been designed specifically for package and cushion analysis. Author

N63-16782 Sandia Corp., Albuquerque, N. Mex.
FACTORS FOR ONE-SIDED TOLERANCE LIMITS AND FOR VARIABLES SAMPLING PLANS
D. B. Owen Mar. 1963 406 p 82 refs
(SCR-607; supersedes SCR-13) OTS: $5.00

Tables are given of a quantity k which is used to define single-sample variables sampling plans and one-sided tolerance limits for a normal distribution. The probability is γ that at least a proportion P of a normal population is below $\bar{x} + ks$, where $\bar{x}$ has a normal distribution with mean μ and variance σ^2/n and fs^2/σ^2 has chi-square distribution with f degrees of freedom. The quantity k just described corresponds to a percentage point of the noncentral t-distribution and is extensively tabulated. Tabulations of other functions computed from the noncentral t-distribution and various expected values are also given. Many other applications are discussed and various approximations compared. One section gives the mathematical derivations, and there is an extensive bibliography which has been cross referenced to several indices of mathematical and statistical literature. Author

N63-16791 Wisconsin U., Madison
A SEMI-MARKOV MODEL FOR CLINICAL TRIALS
George H. Weiss and Marvin Zelen Apr. 1963 31 p 9 refs
(Contract DA-11-022-ORD-2059)
(MRC-396)

The model characterizes the patient as being in one of a finite number of states at any given time with an arbitrary probability distribution to describe the length of stay in a state. Transitions between states are assumed to be chosen according to a stationary finite Markov chain. In this paper the Laplace transforms are obtained for (1) probability of being in a state at time t, (2) probability distribution to reach absorption state, and (3) the probability distribution of the first passage times to go from initial states to transient or absorbing states, transient to transient, and transient to absorbing. The model is applied to a clinical study of acute leukemia treated with methotrexate and 6-mercaptopurine. The agreement of the data and the model is excellent. Author

N63-16809 Northeast Louisiana State Coll., Monroe
A RECURSION PROCESS FOR THE GENERATION OF ORTHOGONAL POLYNOMIALS IN SEVERAL VARIABLES
Daniel E. Dupree, F. L. Harmon, J. L. Linnstaedter, Lawrence Browning, and R. A. Hickman *In* NASA. Marshall Space Flight Center Progress Rept. No. 3 on Studies in the Fields of Space Flight and Guidance Theory [June 15–Dec. 20, 1962] Feb. 6, 1963 p 181–188 2 refs (See N63-16801 14-01) OTS: $15.00 ph, $6.98 mf
(Sponsored by NASA. Marshall Space Flight Center)

A recursive process for generating multivariable orthogonal polynomials is developed. Author

N63-16810 Chrysler Corp. Missile Div., Detroit, Mich.
NUMERICAL APPROXIMATION OF MULTIVARIATE FUNCTIONS APPLIED TO THE ADAPTIVE GUIDANCE MODE (PART II)
R. J. Vance *In* NASA. Marshall Space Flight Center Progress Rept. No. 3 on Studies in the Fields of Space Flight and Guidance Theory [June 15–Dec. 20, 1962] Feb. 6, 1963 p 189–199 8 refs (See N63-16801 14-01) OTS: $15.00 ph, $6.98 mf
(Sponsored by NASA. Marshall Space Flight Center)

A procedure using quadrature methods and combinatorial topology is described for computing values of integrals in n-dimensions. This offers one way of solving the problem of data-point selection for the generation of a least-squares approximation of a multivariate function by a linear combination of polynomials which are orthonormal over a region. Author

N63-16811 North Carolina U. Computation Center, Chapel Hill
THE APPLICATION OF LINEAR PROGRAMMING TO MULTIVARIATE APPROXIMATION PROBLEMS
Shigemichi Suzuki and Sylvia M. Hubbard in NASA. Marshall Space Flight Center Progress Rept. No. 3 on Studies in the Fields of Space Flight and Guidance Theory [June 15–Dec. 20, 1962] Feb. 6, 1963 p 200–220 13 refs (See N63-16801 14-01) OTS: $15.00 ph, $6.98 mf
(Sponsored by NASA. Marshall Space Flight Center)

The purpose of this work is to obtain simple, formal functions which approximate, in some sense, the steering and cutoff functions derived in the adaptive guidance mode. The approach taken in this report is to use linear programing techniques to fit linear combinations of known functions or ratios of such functions to a set of tabulated values of the steering and cutoff functions. Author

N63-16825 European Atomic Energy Community, Brussels (Belgium)
A MULTISTAGE SEARCH GAME
M. F. Neuts 1963 13 p refs
(Contract Euratom 11-61-1 CETB)
(EUR 257.e) Available from Belgium American Bank and Trust Co., N.Y., account No. 121.86: 25 Belg. Fr.

The problem of optimally searching a set of boxes for a hidden object is formulated as a game. The model is such that parameters account for the possibility of overlooking the object in a single search. Optimal stationary strategies are obtained and used to construct a monotonely converging to Bellman's functional equations. It is felt that this result may be of use in the optimization of machine searches of data systems. Author

N63-16830 California U., Los Angeles. Numerical Analysis Research
BOUNDS FOR ITERATES, INVERSES AND SPECTRAL VARIATION OF NONNORMAL MATRICES
Edward Arthur Sallin (Ph. D. Thesis) June 1963 105 p 29 refs
(Contract Nonr-233(76); Grant DA-ARO(D)-31-124-G77)

The following problems of computational linear algebra are considered: (1) Given an arbitrary square matrix A, to explicitly construct and determine a bound for a condition number of a matrix N such that $Q = N^{-1}/An$ is quasi-diagonal; (2) to estimate the norms of A^n, $n = 1,2,\ldots$ in terms of the eigenvalues of A and $C_p(N)$; (3) to estimate the error $\tilde{x} - A^{-1}b$ of an approximate solution $\tilde{x}$ of the equation $Ax = b$ in terms of the residual $r = a\tilde{x} - b$, the eigenvalues of A and $C_p(N)$, and to estimate the error $\tilde{X} - A^{-1}$ of an approximate inverse $\tilde{X}$ of A in terms of the residual $A\tilde{X} - I$, the eigenvalues of A and $C_p(N)$; and (4) to estimate the distance of the spectrum of an arbitrary matrix B from the spectrum of A in terms of a norm of $B - A$, eigenvalues of A and $C_p(N)$.
M.P.G.

N63-16833 Stanford Research Inst., Menlo Park, Calif.
COMPUTER SIMULATION ROUTINE FOR RADIO FREQUENCY BACKSCATTER: ANALYSIS FOR COMPUTER GENERATION OF NOISE Technical Report No. 2
G. W. Evans II, R. C. Mc Carty, W. C. Cutler and L. Leving May 1962 20 p 4 refs
(ARPA SD-103; ARPA Order 281-62)
(AD 277582)

This report covers the computer simulation of the amplitude of noise signals which are bounded and are either time dependent or time independent. In the cases considered, it is assumed that there exists a cumulative distribution function for the amplitudes of the noise signal. Author

N63-16873 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
THE IDENTIFICATION OF OVERDAMPED PROCESSES IN THE TIME DOMAIN
Jerry M. Mendel Apr. 19, 1963 151 p 34 refs
(Grant AF-AFOSR-62-280)
(PIBMRI-1131-63)

The problem of characterizing overdamped systems, from data in the time-domain, by means of exponential functions is studied. Particular attention is given to: (1) the choice of a suitable error criterion based upon performance measures the approximate system is to meet, (2) the choice of weighting functions and their effect on the approximations, and (3) the extension of the orthonormal exponential approximations of Kautz and Huggins to approximations of any asymptotic-order in the s-domain. Author

N63-16898 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)
EIGHTFOLD WAY AND WEAK INTERACTIONS
Michel Gourdin [1963] 25 p 22 refs
(Partially Sponsored by AFOSR)

A generalization of the octet model is presented that includes the weak electromagnetic interactions. An eight-fold method based on the orthogonal group in an eight-dimensional space SO(8) appeared to be the most simple solution. The mathematical structure of the inclusion between the algebra of the unitary group and the algebra of the orthogonal group is studied. The reduction under unitary transformation of the irreducible representations of the orthogonal group is examined, and it can be shown that the orthogonal SO(8) group can generalize the octet model but not the triplet model. Moreover, the adjoint representation contains the weak current which can be used to extend the octet model. The model is constructed explicitly and a systematic classification of the weak currents with respect to the quantum numbers of the strong interactions is given. N.E.A.

N63-16947 California U., Los Angeles
MAPPINGS INTO ABSTRACT RIEMANN SURFACES
Derek Joseph Haggard Fuller May 1963 76 p 11 refs
(Grant DA-ARO(D)-31-124-G40)
(Tech. Rept. 33; AROD-1517-52)

The object of this paper is the study of analytic mappings into a Riemann surface with the aid of a family of LH functions t defined on the surface. In the special cases of the plane and the sphere, the functions $\log|(\zeta-\alpha)/(\zeta-\beta)|$ for arbitrary α and β, form such a family. We obtain extensions of Jensen's formula and the argument principle to mappings of one surface into another. A first main theorem is developed which leads to a natural generalization of R. Nevanlinna's functions of bounded characteristic. The idea of the logarithmic capacity of a compact set in the plane is extended to compact sets in an arbitrary surface by means of the t functions. A criterion is obtained for analytic mappings of a parabolic surface into a surface obtainable from a closed surface by omitting a finite number of points. A second main theorem of the "exceptional interval" type is obtained for mappings of a W_p surface into a closed surface. We derive from it the analog of the Picard–Borel theorem. Author

21 METEOROLOGY

Includes: climatology; weather forecasting; lower atmosphere studies; and oceanography.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N63-16341 Martin Co., Denver, Colo.
THE ATMOSPHERE AT CAPE CANAVERAL, FLORIDA FOR 624A SSLV Meteorological Report No. 1
Jerome M. Bidwell Jan. 29, 1963 49 p 12 refs

A description is given of the 624A Nominal AMR Atmosphere. The 624A Nominal AMR Atmosphere is compared with the 1962 U.S. Standard Atmosphere and the Summer and Winter Supplemental Atmospheres for 30° N latitude. Seasonal, monthly, daily, 12-hour, and 6-hour variability of density are discussed. Author

N63-16347 Cambridge Systems, Inc., Newton, Mass.
AN/GMD-2 WIND ERRORS FROM SALTON SEA TEST SERIES Final Report
D. P. Keily and D. J. Beaubien Apr. 1963 39 p 3 refs
(Contract AF 19(628)-1686)
(AFCRL-63-463)

The results of the Salton Sea Meteorological Instrumentation Test Series (MITS) are analyzed and extended to include root-mean-square errors in the wind speed, range, elevation, and azimuth angles, as measured by the AN/GMD-2 Rawin Set, for a series of representative flights. Criteria are presented as guidelines for conducting additional field tests in order that such tests will generate sufficient data to permit the determination of rms wind errors to a higher degree of confidence and accuracy than that which is currently attainable. An effort is made to categorize the wind errors derived, on the basis of established errors in the altitude, slant range, azimuth, and elevation angles. Author

N63-16359 Stanford Research Inst., Menlo Park, Calif.
CLIMATOLOGICAL APPLICATIONS OF VERTICALLY POINTING WEATHER RADAR OBSERVATIONS Scientific Report No. 5
Roy H. Blackmer and Myron G. H. Ligda Feb. 1963 44 p 10 refs
(Contract AF 19(604)-7312)
(AFCRL-63-299)

The discussion includes such factors as the optimum tilt angle and antenna rotation rate to detect scattered clouds that are often missed by a fixed vertical antenna. Examples of the probable appearance of several cloud distributions as shown by fixed and scanning antennas are presented. A method of summarizing the data for climatological purposes by the utilization of punched cards is presented. Author

N63-16366 Pennsylvania State U. Coll. of Mineral Industries, University Park
THE ROLE OF OROGRAPHIC BARRIERS OF LESS THAN 3000 FEET IN THE GENERATION AND PROPAGATION OF SHOWERS [Summary Report]
C. L. Hosler, L. G. Davis, and D. R. Booker Dec. 1962 174 p 53 refs
(NSF Grant G-7363)

Radar and other observational means have been used over the past several years to investigate the convective showers which occur in central Pennsylvania. It has been found that vertical motions associated with mountain wave patterns over central Pennsylvania influence significantly the formation and dissipation of cumulus cloud systems and subsequent showers. D.E.R.

N63-16380 Massachusetts U., Amherst
EOLIAN GEOMORPHOLOGY, WIND DIRECTION, AND CLIMATIC CHANGE IN NORTH AFRICA Final Report
H. T. U. Smith Mar. 1963 70 p 28 refs
(Contract AF 19(628)-298)
(AFCRL-63-443)

The effect of the wind, over long periods of time, on the structure of the desert region of North Africa is discussed, and the evolution of the geological features of the region due to the erosional effects of the winds, especially those of the Pleistocene era, is presented. It has been found that the Sahara region is an ideal natural laboratory for studying eolian geology and geomorphology, and that many of the factors influencing the geological structure of that area also apply to the desert areas of the North American continent. D.E.R.

N63-16382 Lockheed Missiles and Space Co., Sunnyvale, Calif.
WIND SHEAR RESPONSE FOR MISSILE SYSTEMS
C. J. Van Der Maas Mar. 30, 1962 70 p 15 refs
(LMSC-A003108 A)

A survey of available wind-shear data was conducted, and the results were related to current design practices for vertically rising missiles. In addition, the responses of several different kinds of vehicles were obtained by means of a 6-dimensional trajectory computer program. A design procedure was developed for the construction of a design response diagram. This relates the vehicle response to the maximum wind velocity, its probability distribution, and the probability distribution of the integrated area. Since no statistics in the integrated area are available, a method of estimation was also developed, involving the use of four design wind profiles. These design diagrams are useful during all phases of design, as well as prelaunch checkout. A detailed discussion is presented of the probability concepts involved showing that, in most cases, the probability of occurrence can only be defined by "much less than" a certain percentage. Author

N63-16397 Texas A. and M. Research Foundation, College Station, Tex.
THE TEXAS DEW POINT FRONT AS SEEN BY TIROS I Scientific Report No. 3
Walter K. Henry and Aylmer H. Thompson Feb. 1, 1963 33 p 6 refs
(Contract AF 19(604)-8450)
(AFCRL-63-244)

The general behavior of the West Texas dew point front and the related cloud patterns are described. Several Tiros I pictures of West Texas and the surrounding area were selected for special study; these pictures included, also, examples when the dew point front was absent. The examples generally showed good agreement between the dew point front and cloud pattern as pictured by the satellite. The match between the cloud patterns and the location of the dew point front was not perfect, due partly to the thin layer of moist air near the surface location of the dew point front, and occasionally, higher cloud layers, usually cirrus, which partially masked the location of the dew point front as pictured by the satellite. A few cases occurred where cloud patterns similar to those associated with the dew point front were present, but for which no dew point front was present. Of special interest is a case of "collapse" and "surge" of the dew point front. Author

N63-16454 Stanford Research Inst., Menlo Park, Calif.
CLOUD RESEARCH DATA Final Report
S. M. Serebreny and R. H. Blackmer, Jr. Feb. 1963 36 p 29 refs
(Contract AF 19(604)-7312)
(AFCRL-63-400)

This report presents a summary and analysis of research on cloud cover conducted over a three-year period. During this time various sources of cloud data such as WBAN-10 reports, whole-sky photographs, vertically pointing radar records, and high-altitude photographs from U-2 aircraft and Tiros satellites were subjected to detailed analyses. From these analyses, knowledge is gained of: (1) the occurrence of multiple layers of clouds, (2) the frequency with which upper layers above an overcast may not be detected by a surface observer, (3) the length, width, and height of cumuliform clouds, and (4) the size distributions of cloud elements composing a given number of tenths of cumulus cloud cover. Examples of our methods of treating these data, including pertinent illustrations and tables, are presented. Author

N63-16534 Hanford Atomic Products Operation, Richland, Wash.
FREQUENCY ANALYSIS OF SOME CLIMATOLOGICAL EXTREMES AT HANFORD
D. E. Jenne May 17, 1963 39 p 3 refs
(Contract AT(45-1)-1350)
(HW-75445) OTS: $0.75

This report presents figures showing the expected frequency of climatological extremes already experienced at Hanford, as well as the frequency with which still greater extremes can be

expected. These figures also provide a basis for specifying a period of time of recurring extremes, which time may be in centuries, and to estimate the magnitude of an extreme which can be expected within that period. I.v.L.

N63-16581 Cornell U. Agricultural Research Service, Ithaca, N.Y.
THE ENERGY BUDGET AT THE EARTH'S SURFACE: ANALYSIS OF MICROMETEOROLOGICAL VERTICAL PROFILES FOR THE EVALUATION OF SURFACE CHARACTERISTICS AND VERTICAL FLUXES
Edgar R. Lemon and Winton Covey Dec. 1962 51 p Presented in part to the Fourth Meeting of Researchers in Micrometeorology at Fort Huachuca, Ariz., Mar. 28, 1962
(USAEPG Cross Service Order 2-62)
(Paper 586; Interim Rept. 62-5; Res. Rept. 361)

The equations for analysis of simultaneous micrometeorological profiles have been presented for assumed logarithm-of-height plus power-of-height similar profiles. Detailed procedures are given for the method using the first power of height as the additional term to the Log–Law equation. Some illustration computations are given, based on data obtained at O'Neill, Nebraska, in 1953 by the John Hopkins group. Computer programs are included. Author

22 NAVIGATION AND GUIDANCE

Includes: autopilots; star tracking; inertial platforms; and traffic control.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; 20 Mathematics; and 29 Space Sciences.

N63-16546 Rome Air Development Center. Control Systems Lab., Griffiss AFB, N.Y.
CATEGORY II/III TEST OF THE AN/GSN-5A
James R. Prichard Apr. 1963 33 p
(RADC-TDR-63-166)

The Landing Control, Central, AN/GSN-5A is a ground-based, final approach navigation system providing three basic approach and landing techniques. These include completely automatic control, cross-pointer guided approach, and talkdown. These techniques used singularly or in combination maintain aircraft surveillance and guidance information to touchdown. Test aircraft used in the Category II Program were an F-102A, KC-135 and an RB-57. In Category III, test aircraft were an F-105, B-57, B-52, T-33, T-38, B-47, F-106, F-101, and an F-100. The F-102A was the primary automatic-landing test vehicle. Test results are presented in the form of graphs, tables, and general comments, and form a basis for the conclusions and recommendations. Author

N63-16826 General Precision, Inc., Tarrytown, N.Y.
STUDY OF MULTI-FUNCTION SENSORS FOR GUIDANCE SUBSYSTEMS Third Quarterly Technical Note [Jan. 1-Mar. 1963]
Alan Bloch Wright-Patterson AFB, Ohio, Aeronautical Systems Div., May 1963 42 p
(Contract AF 33(657)-9207)

The purpose of the program is the ultimate development of multifunction sensors for space-vehicle guidance and navigation. This report contains detailed discussions of the work carried out during the reporting period. A section is devoted to the theory of overlapping Fresnel-zone plates. Author

N63-16855 American Bosch Arma Corp., Garden City, N.Y.
PRECISION INDEXING OF AN ACCELEROMETER TO FACILITATE THE MEASUREMENT OF HIGHER-ORDER NONLINEARITIES
J. Ebbinghaus *In* Air Force Missile Develop. Center Proc. of the AFMDC Inertial Guidance Test Symp., Vol. I, Holloman AFB, 16–17 Oct. 1962 p I-1–I-25 2 refs (See N63-16854 14-01)

The present test methods and equipment for determining the precision of accelerometers are reviewed and an improved measuring technique is presented as an outcome of this review. It is found that the techniques using a centrifugal accelerator to measure the characteristics of accelerometers are insufficient for precision applications and subtle design changes or refinements, and that problems of accelerometer alignment, speed and angular velocity duplication, temperature control, and arm length changes are always present. D.E.R.

N63-16859 General Precision, Inc. Kearfort Div., Little Falls, N.J.
TESTING OF STELLAR INERTIAL GUIDANCE SYSTEMS
Bernard Lichtenstein *In* Air Force Missile Develop. Center Proc. of the AFMDC Inertial Guidance Test Symp., Vol. I, Holloman AFB, 16–17 Oct. 1962 p V-1–V-18 4 refs (See N63-16854 14-01)

The factors which must be considered in developing a means of testing stellar or celestial inertial guidance systems are presented. It is found that greater precision and accuracy will be demanded of testing equipment and new techniques of testing will have to be developed to evaluate stellar inertial guidance systems and their components. And most important, the entire sled testing program will have to undergo an evaluation, and new programs may be necessary. D.E.R.

N63-16860 Space Technology Labs., Inc., Los Angeles, Calif.
A LONG HARD LOOK AT GUIDANCE SYSTEM TESTING PROGRAMS
A. N. Drucker *In* Air Force Missile Develop. Center Proc. of the AFMDC Inertial Guidance Test Symp., Vol. I, Holloman AFB, 16–17 Oct. 1962 p VI-1–VI-20 (See N63-16854 14-01)

The various testing programs and test methods of ballistic missile guidance systems are examined and it is found that the flight test programs are growing exceedingly expensive, costing millions of dollars before the accuracy and performance characteristics of the missile system can be reliably predicted. Topics discussed include: the accuracy-evaluation problem, the requirements for a successful guidance-system test program—test requirements and objectives; current test programs—lab tests, centrifuge tests, sled and flight tests, and GEM tests; future inertial-guidance-system accuracy-evaluation programs; and management considerations. D.E.R.

N63-16861 Minneapolis-Honeywell Regulator Co., Minn.
BAND CONCEPT VERSUS STATISTICAL METHOD IN INERTIAL GUIDANCE TESTING
Ralph V. Fenton *In* Air Force Missile Develop. Center Proc. of the AFMDC Inertial Guidance Test Symp., Vol. I, Holloman AFB, 16–17 Oct. 1962 p VII-1–VII-12 (See N63-16854 14-01)

The present inertial guidance system testing method and the accompanying analysis of data assumes that all the variables present during the test are independent, but analysis of the basic data shows that this is not the case. Rather, the variables have measurable boundary limits which can be expressed as a basic stability band. The mean of this band will vary as a function of the external environment, which variations can also be expressed as a band. Therefore, since the basic stability band and the mean stability band are independent, they may be combined statistically to predict the performance of all operational concepts in all environments. D.E.R.

N63-16864 Space Technology Labs., Inc., Los Angeles, Calif.
GUIDANCE SYSTEM EVALUATION USING THE GUIDANCE EVALUATION MISSILE
L. N. Jenks and J. R. Westlake *In* Air Force Missile Develop. Center Proc. of the AFMDC Inertial Guidance Test Symp., Vol. I, Holloman AFB, 16–17 Oct. 1962 p X-1–X-18 (See N63-16854 14-01)

This paper explores the utilization of the Guidance Evaluation Missile (GEM) as a vehicle for the evaluation of inertial guidance system accuracy at the system level. It is suggested that the standard for system accuracy be developed by applying the system operational error budget to the GEM trajectory, thus achieving an allowable velocity-error bound as a function of flight time. The actual velocity error from the GEM test may then be compared with this bound to obtain a measure of system accuracy. The actual velocity error can be obtained by differencing the system velocity measurement (via telemetry) with GEM velocity as measured by an external tracking system. The GEM system test technique has many advantages, prominent among these being low test cost compared to AMR/PMR, recovery and reuse of the test system, and a test capability of production hardware long after the R & D flight-test program has terminated. Author

N63-16865 Massachusetts Inst. of Tech., Cambridge
INERTIAL GUIDANCE EQUIPMENT TESTING ON THE MIT PRECISION CENTRIFUGE WITH COMPARISON SLED TESTING
John M. Buchanan *In* Air Force Missile Develop. Center Proc. of the AFMDC Inertial Guidance Test Symp., Vol. I, Holloman AFB, 16–17 Oct. 1962 p XI-1–XI-33 (See N63-16854 14-01)

The technical features of three types of centrifugal inertial guidance equipment tests are described and the precision of performing them on the MIT centrifuge is discussed. The value of centrifuge testing over sled testing is noted, but the particular advantages of sled tests, the evaluation of IMU errors and gyro drift coefficients, are discussed. D.E.R.

23 PHYSICS, GENERAL

Includes: acoustics; cryogenics; optics; and thermodynamics.

For astrophysics see: 05 Astronomy and Astrophysics.

For related information see: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 24 Physics, Solid-State.

N63-16342 Pennsylvania U. Lab. for Research on the Structure of Matter, Philadelphia
CLUSTER EXPANSION FOR THE HEISENBERG FERROMAGNET Technical Report No. 5
Bertram Strieb, Herbert B. Callen, and Gerald Horwitz (Weizmann Inst. of Sci. and Hebrew U., Israel) Dec. 1962 38 p 14 refs
(Contract Nonr-551(36))
(AD-295727)

A cluster series is derived for the Heisenberg ferromagnet. The theory is evaluated in zero order, for two-spin clusters, and for three-spin renormalized clusters. The zero-order result is the Weiss molecular field approximation, and the two-spin cluster is identical to the constant coupling approximation. The three-spin cluster result does not coincide with any existing phenomenological cluster approximation. The origin and nature of the inconsistencies in the phenomenological cluster methods are discussed. Author

N63-16343 Pennsylvania State U., University Park
ELASTIC-PLASTIC RESPONSE OF A SLAB TO A HEAT PULSE Technical Report No. 6
Yip-Chie Lee and Walter Jaunzemis Mar. 1963 167 p 57 refs
(Contract AF-AFOSR-128-63)

Thermodynamically valid, nonisothermal stress strain relations are established for the elastic–plastic range, and solutions are obtained for typical one-dimensional problems involving unsteady temperatures. First, the entropy balance equation and the expression for production of internal entropy are considered, in order to characterize the elastic-plastic response. The general theory is applied to the case of an infinite half-space constrained against lateral motion and subjected to a heat pulse uniformly applied over its boundary. The solution of the half-space problem is extended to related problems for an infinite plate of finite thickness constrained in the lateral direction. The expressions for predicting maximum residual stresses and strains are found to be obtained directly from the solution of the half-space problem. Numerical results are given for transient and residual stresses and strains in an aluminum alloy; and the maximum boundary temperature corresponding to the recurrence of plastic flow during a second heat pulse is determined, assuming that the conditions produced by the first heat pulse have reached a steady state. Although the problem selected is one-dimensional, this method of approach and the basic equations developed may be used in the analysis of thermal stress problems in two or three dimensions. M.P.G.

N63-16354 Stanford U. Stanford Linear Accelerator Center, Calif.
TWO-MILE ACCELERATOR PROJECT Final and Quarterly Status Report, April 1–June 30, 1962
July 1962 81 p
(Contracts AT(04-3)-363; AT(04-3)-400)
(SLAC Rept. 1) OTS: $2.00

The use of the Mark IV accelerator as a test vehicle has developed satisfactorily. Two-shift per day operation has been continued when running experiments, and the machine capability and reliability have been improved to the point where the full power-supply voltage available is used routinely. Although the machine has been operating as described, much is planned and underway to increase its peak- and average-power capability and to improve and expand the instrumentation and control facilities. Author

N63-16370 Boeing Co. Aero-Space Div., Seattle, Wash.
STUDIES OF ROCKET NOISE SIMULATION WITH SUBSTITUTE GAS JETS AND THE EFFECT OF VEHICLE MOTION ON JET NOISE [Final Report]
Walter V. Morgan and Kenneth J. Young Wright-Patterson AFB, Ohio, Flight Dynamics Lab., Mar. 1963 98 p 24 refs
(Contract AF 33(616)-8201)
(ASD-TDR-62-787)

The feasibility of using helium jets as a practical substitute for actual rockets in scale-model acoustic tests was investigated by conducting an experimental program with four heated helium models. Sufficient evidence is presented to indicate that the substitute-gas modeling concept is valid, i.e., simulation of rocket noise can be achieved if the essential rocket flow parameters are duplicated. Since it is not possible to duplicate all flow parameters simultaneously and still retain the essential feature of simplicity, some compromises must be made. The helium model which provided rocket-exit values of Mach number, velocity, and static pressure, and near duplication of density performed best. This evaluation is based on agreement in sound-pressure levels with a small solid-propellant rocket. An investigation was made to determine the effect of flight vehicle motion on propulsion-system noise which is

propagated to parts of the vehicle located in the near field. Following the selection of a working hypothesis, experiments were performed using a 0.6-inch diameter heated air jet operating in a 16-inch diameter acoustically-treated wind tunnel. Experimental results compare favorably with predictions based on the hypothesis which explains the effect of vehicle motion by two separate factors: (1) the noise produced by a jet in motion is dependent upon the relative velocity between the jet and the air through which it moves; and (2) a shifting of the noise radiation pattern toward the rear occurs because of the combined effects of vehicle motion and the finite velocity of sound. A prediction method is developed which makes use of noise data from a stationary jet operated at a velocity corresponding to the relative jet velocity of a moving vehicle. These measured data are then translated by a calculated amount to account for the rearward shifting of the noise field due to motion. Author

N63-16376 Brookhaven National Lab., Upton, N.Y.
A REVIEW OF NONLINEAR REACTOR DYNAMICS PROBLEMS
Jack Chernick July 1962 12 p 30 refs Presented at the American Nuclear Society, Boston, June 18, 1962
(Supported by AEC)
(BNL 774 (T-291)) OTS: $0.50

Recent developments in geometrical, algebraical, and physical approaches to reactor dynamics problems are presented and traced to their common origin. A discussion of some of the simpler models of reactor dynamics, the methods developed to solve them, and their limitations is presented. N.E.A.

N63-16383 Army Engineer Waterways Experiment Station, Vicksburg, Miss.
CRATERS FORMED BY SMALL EXPLOSIONS IN DRY SAND
R. A. Sager Sept. 1962 16 p 1 ref
(CE/WES MP-2-524; AD-291494)

Results of a series of cratering shots fired over, on, and within a dry sand media are presented. Four-pound TNT demolition charges were used, and the charge depth was referenced to the center of gravity of the charge. Positive values of charge depth (Z and λ_c) denote charges placed above ground; negative values denote charges placed underground. Two shots were detonated at each of 10 different reduced charge positions with a maximum λ_c of 1.0 and a minimum of -0.26. All above-ground shots resulted in symmetrical craters with relatively flat bottoms and gently rising side slopes; shots at ground surface or below resulted in symmetrical craters with steeper side slopes. For λ_c values of 0.2 and greater, the apparent crater diameters are consistent; below 0.2, crater diameter increases with decreasing λ_c. Increases in λ_c above 0.6 influence crater depth mainly through the scouring action of the air blast wave; for λ_c values less than 0.6, crater depth increases with decreasing λ_c. Below a value of 0.4, crater area and volume increase with decreasing λ_c. The optimum charge position to produce maximum crater area and volume is below $\lambda_c = 0.26$. M.P.G.

N63-16404 Michigan U. Inst. of Science and Tech., Ann Arbor
DEVELOPMENT OF A FAST SOLID-STATE ULTRAVIOLET PHOTODETECTOR [Final Report, June 1961-Aug. 1962]
Douglas E. Brown, Richard C. Keezer, and Joseph Mudar Wright-Patterson AFB, Ohio, Electronic Tech. Lab., Mar. 1963 39 p 12 refs
(Contract AF 33(616)-8410)
(Rept. 4611-13-F; ASD-TDR-62-978)

The objective of this work was to develop a fast solid-state ultraviolet detector. Efforts were concentrated on photovoltaic devices using metal semiconductor barrier layers. Peak detectivities of 10^9 cm cps$^{1/2}$/watt, and time constants of less than 120 μsec were achieved with both ZnS (λ peak = 339 mμ) and TiO_2 (λ peak = 320 mμ) MgO was found to be photoconductive when exposed to radiation of wavelength less than 260 mμ. Trapping states in TiO_2 were investigated by means of the method of space-charge-limited currents. Author

N63-16419 Hanford Atomic Products Operation, Richland, Wash.
PHYSICS RESEARCH QUARTERLY REPORT, OCTOBER, NOVEMBER, DECEMBER, 1962 Preliminary Report
F. G. Dawson, Jr., et al May 2, 1963 66 p 40 refs
(Contract AT(45-1)-1350)
(HW-76128) OTS: $1.75

Reports presented are as follows: (1) Variational Optimum Kinetic Normal Modes; (2) The Integration of the Egelstaff S-Function; (3) Two Zone Subcritical Measurements with 1.8 wt% Pu-Al Fuel Rods in Light Water; (4) P-3 Calculations of Thermal Flux Distributions in Lattices Fueled with Plutonium; (5) An Analysis of Pu-Al-Fueled Graphite-Moderated Lattices; (6) Changes in Resonance Absorption in Pu^{240} with Temperature for Pu-Al Fuel; (7) A Measurement in the Physical Constants Testing Reactor of the Relative Plutonium Content of Pu-Al Fuel Elements; (8) The Beta-Ray Spectrum of Lu^{176m}; and (9) Critical Mass Experiments with Plutonium Nitrate. I.v.L.

N63-16447 Battelle Memorial Inst., Columbus, Ohio
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JANUARY, 1963
Russell W. Dayton and Ronald F. Dickerson Feb. 1, 1963 85 p refs
(Contract W-7405-eng-92)
(BMI-1614(Del)) OTS: $2.00

Progress reports, relating to civilian applications for reactors, reactor materials, etc., are presented. Topics covered are: reactor materials and components, studies of fuels, studies of PuN and its alloys, general fuel element development, radioscope and radiation applications, development of a tracer system for in-place filter evaluation, materials development and evaluation, coated particle fuel materials, corrosion studies of the fluoride volatility process, progress on USAEF/AECL cooperative program, fission-product deposition studies, irradiation of materials and components, gas-cooled reactor program, process development and evaluation properties of F-48 Niobium Alloy, and joining of regenerative cell components. J.A.J.

N63-16479 Rhode Island U. Div. of Engineering Research and Development, Kingston
RAYLEIGH WAVE TRANSMISSION ON ELASTIC WEDGES [Scientific Report No. 1]
Julius Kane and John Spence Jan. 1963 24 p 3 refs
(Contract AF 19(628)-319; ARPA Order 180-62; ARPA Order 292-62; Proj. Vela-Uniform)
(Rept. 319/1; AFCRL-63-258)

A method is introduced by which transmission or conversion coefficients can be readily calculated for surface-wave diffraction at crustal discontinuities which can be idealized as wedge-shaped obstacles. The method, an iteration procedure, is illustrated by an application to Rayleigh-wave propagation on elastic wedges with free boundaries. It is shown that the leading term of the iteration procedure yields an expression for the transmission coefficient which matches the experimental data for a range of wedge angles, which includes the crustal wedges commonly found in seismic practice. Numerical data are presented which illustrate the transmission coefficient's variation in terms of Poisson's ratio, and the wedge angle. Author

N63-16488 Bureau of Mines. Tuscaloosa Metallurgy Research Center, Ala.
THERMODYNAMIC PROPERTIES OF BERYLLIUM SULFATE FROM 0° to 900°K
A. R. Taylor, Jr., T. Estelle Gardner, and D. F. Smith 1963 12 p 8 refs Work done on an agreement between Bureau of Mines and Alabama U.
(BM-RI-6240)

The Bureau of Mines has determined the heat capacity and enthalpy values for beryllium sulfate ($BeSO_4$) throughout the temperature ranges of 10° to 300° K in an adiabatic calorimeter, and 350° to 860° K in a Bunsen-type ice calorimeter. The heat-capacity data were extrapolated to 0° K, and smooth values of heat capacity, entropy, enthalpy function, and free-energy function were reported at 10-degree intervals between 0° and 300° K. The method of least squares was used to fit the enthalpy data with an algebraic equation. The equation also was used to calculate values of heat capacity, entropy, enthalpy function, and free-energy function at 50-degree intervals between 300° and 900° K. Author

N63-16502 California U., Berkeley. Lawrence Radiation Lab.
BASIC THEORY AND APPLICATION OF REGGE POLES
C. Edward Jones and John A. Poirer Feb. 8, 1963 38 p 28 refs
(Contract W-7405-eng-48)
(UCRL-10677) OTS: $1.00

This paper gives a development of the basic theory of Regge poles. The goal has been to give a self-contained discussion which can be easily read without prior background knowledge of the subject. Emphasis is on physical ideas and experimental consequences rather than on rigor. The attempt has been made to state explicitly the underlying assumptions behind the Regge-pole hypothesis. Author

N63-16504 California U., Berkeley. Lawrence Radiation Lab.
THE ACTIVATION ENERGY FOR THE SUBLIMATION OF GALLIUM NITRIDE
Zuhair A. Munir Mar. 14, 1963 51 p 37 refs
(Contract W-7405-eng-48)
(UCRL-10702) OTS: $1.00

Mass-spectroscopic measurements were used to demonstrate that gallium vaporizes almost exclusively as gallium atoms, and that gallium nitride vaporizes as gallium atoms and nitrogen molecules. The vapor pressure of gallium was measured by the torsion-effusion method between 1174° and 1603° K. The pressure, in atmospheres, is given by the expression: $\log P = 5.458 - (13{,}743/T)$ in that temperature range. The heat of sublimation of gallium is calculated by the second-law method to be 63.5 kcal/mole when extrapolated to 298° K, while the value calculated by the third-law method is 65.44 ±0.23 kcal/mole. These values are in excellent agreement with the selected value of $\Delta H^{\circ}_{298} = 65.3 \pm 1.0$ by Hultgren. The rate of the reaction GaN(s) = Ga(g) + 1/2 N_2(g) was measured by a torsion-Langmuir method. Heats of activation were calculated to be $\Delta H_{298} = 125.4$ kcal/mole and $\Delta H_{298} = 127.50$ kcal/mole by the second-law and third-law methods, respectively. Entropies of the slow step were found to be $\Delta S_{298} = 54.85$ eu by the second-law method and $\Delta S_{298} = 52.92$ eu by the third law method. The close agreement in these values implies that the rate-determining step is the final step of escape of gallium or nitrogen molecules from the surface, rather than an earlier surface diffusion step. It is proposed that the slow step is the formation and immediate desorption of N_2 molecules from the surface. Author

N63-16539 Atomic Energy Commission, Bombay (India)
A HYDRODYNAMIC MODEL OF RADIOACTIVITY
S. Gangadharan and R. Krishnamoorthy Iyer 1963 20 p 10 refs
(AEET-Anal.-6)

The rate of flow of water from a cylindrical reservoir through a capillary tube is exponential with respect to time. This principle is made use of in demonstrating the decay of a radionuclide, the growth of a daughter from a parent, attainment of radioactive equilibrium and other parent-daughter relationships. Since the half-life of the system can be fixed at will, such demonstrations can be performed in a short period of time. Further applications of this device are also suggested. Author

N63-16544 Oak Ridge National Lab., Tenn.
ANNEALING OF GAMMA RAY INDUCED CHANGES IN ANTIMONY DOPED GERMANIUM
Jay Cee Pigg May 28, 1963 109 p refs
(Contract W-7405-eng-26)
(ORNL-3443) OTS: $2.25

An investigation of the annealing of the radiation-induced carrier concentration change in antimony doped germanium, in the temperature range between 370° K and 455° K has been made. The irradiations were conducted at liquid-nitrogen temperature using cobalt-60 gamma irradiation. A model which explains the observed behavior is presented. Author

N63-16555 Uppsala U. Quantum Chemistry Group for Research in Atomic, Molecular and Solid-State Theory (Sweden)
ON THE CALCULATION OF SOME ATOMIC INTEGRALS CONTAINING FUNCTIONS OF r_{12}, r_{13} AND r_{23}
Yngve Ohrn and Jan Nordling Nov. 30, 1962 31 p 8 refs
(Contract AF 61(052)-351)
(TN-91; ARL-63-97)

Different forms of correlated atomic wave functions and their implications on the integrals occurring in calculations of variational solution to Schrödinger's equation are discussed. Author

N63-16559 Atomics International, Canoga Park, Calif.
MAGNETIC SUSCEPTIBILITIES OF MOLTEN Bi-BiI_3 SOLUTIONS
L. E. Topol and L. D. Ransom May 31, 1963 27 p 20 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8085) OTS: $0.50

Magnetic susceptibility measurements were made with a Gouy balance on molten Bi–BiI_3 solutions at 450° to 600°C over the entire composition range. The susceptibilities were diamagnetic throughout, but were found to become less diamagnetic as temperature increased. This temperature dependence varied with concentration of bismuth, and was greatest in the 30 to 70 mole percent Bi solutions. The molar susceptibility as a function of mole fraction of bismuth showed slight deviations from simple additivity in a diamagnetic direction in the salt-rich region and larger deviations from additivity in a paramagnetic direction in the metal-rich melts. This magnetic behavior is discussed in terms of possible chemical species as well as the free electron model. Author

N63-16568 Rochester U., N.Y.
ϕ–MESON AND UNITARY SYMMETRY MODEL
S. Okubo May 8, 1963 14 p 17 refs
(Contract AT(30-1)-875)
(NYO-10264)

An investigation of the properties of the ϕ-meson within the framework of the unitary symmetry model includes: (1) the computation of the eigenvalues for the masses of the vector octet ($\rho, \omega, \kappa^*, \bar{\kappa}^*$); (2) the decay of the ϕ-meson into $\kappa + \bar{\kappa}$; and (3) a unified theory for explaining the experimental results derived from investigations (1) and (2). I.v.L.

N63-16570 California U., Los Angeles
A PERTURBATION THEORY OF THE HEISENBERG ANTIFERROMAGNET Technical Report No. 6
Donald Lynd Bullock (Ph. D. Thesis - June 1963) May 1963 150 p 41 refs
(Contract Nonr-233(63))

The determination of some physical parameters of the ground state for the Heisenberg antiferromagnet is considered. This problem has been completely solved heretofore only in the cases of the energy and short-range order parameters for the linear chain with spin one-half. In this dissertation, the problem of more general lattices and of arbitrary spin is considered, and the long-range order parameter is treated in addition. The results are reported in terms of series expansions generated by means of a modified Rayleigh–Schrodinger perturbation theory, which is proposed and developed in this dissertation. Author

N63-16571 California U., Berkeley. Lawrence Radiation Lab.
EFFECTS OF THE SINGLE PION EXCHANGE IN THE REACTION $p + p \rightarrow n + p + \pi^+$
Joseph T. Lach (Ph.D. Thesis) Mar. 11, 1963 110 p 33 refs
(Contract W-7405-eng-48)
(UCRL-10718) OTS: $2.25

The distribution of neutrons in energy and angle from the reaction $p + p \rightarrow n + p + \pi^+$ at an incident proton momentum of 2.5 Bev/c is studied. The coordinates of the three final-state particles are measured by an array of plastic scintillation counters, the energy of the recoil neutron being determined through its flight time. The range of measured neutron angles is limited to 4 to 60 deg, and the range of recoil momentum is from approximately 150 to 330 Mev/c. Data are recorded on magnetic tape in a format directly acceptable to an IBM-7090 computer where sorting and kinematical fitting are done. A Monte Carlo computation is made in which the effects of the complex resolution functions of the apparatus and the fitting code are investigated and used to compute the overall efficiency and resolution of the apparatus. Because of geometrical limitations of the angular region in which the final state pion and proton could be detected, and our inability to distinguish between them in 18% of the events, the analysis is limited to a region of θ^*, the pion–proton scattering angle, bounded by $-0.5 < \cos(\theta^*) < +0.5$. Comparisons are made with predictions of the one-pion exchange model. A Chew–Low extrapolation is performed and deviations from a linear extrapolation are found. The peripheral model predictions of Selleri agree well with the observed position and reasonably well with the observed shape of the 3/2, 3/2 resonance if an integration is made over momentum transfer. The cross section, as a function of momentum transfer, deviates from the predicted behavior. Author

N63-16573 California U., Berkeley. Lawrence Radiation Lab.
ATOMIC BEAM MEASUREMENTS OF THE NUCLEAR SPINS OF COPPER-62 AND IRON-59 AND THE HYPERFINE-STRUCTURE SEPARATION OF COPPER-61 AND COPPER-64
Barbara Marie Dodsworth (Ph.D. Thesis) Apr. 18, 1963 126 p 49 refs
(Contract W-7405-eng-48)
(UCRL-10780) OTS: $2.50

The atomic-beam magnetic-resonance method of the "flop-in" type using the technique of radioactive detection has been employed to measure the nuclear spins of Cu^{62} and Fe^{59}, as well as the hyperfine-structure separation of Cu^{61}, the sign of the moment of Cu^{61}, and an improved value for the $\Delta\nu$ of CU^{64}. The magnetic moment of Cu^{61} was calculated from the Fermi–Segrè formula, using previously measured values for the $\Delta\nu$ and μ_1 of Cu^{63}. The results of the experimental work, together with calculated values of the nuclear magnetic dipole moments, are given. The main body of the thesis contains theory of atomic structure, a description of the experimental apparatus and techniques employed, methods of data analysis, and results. The results are interpreted in terms of simple nuclear shell-model theory. Author

N63-16584 Rocket Power, Inc., Pasadena, Calif.
THE THERMODYNAMICS OF SEVERAL LIGHT METAL OXIDES, HALIDES AND OXYHALIDES Third Quarterly Report, 9 Nov. 1962 through 9 Feb. 1963
J. A. Blauer, M. A. Greenbaum, and M. Farber [1963] 11 p 15 refs
(Contract DA-04-495-ORD-3530; ARPA Order 40-62, Amend. 18)

Previously, the heat of formation and entropy of the trimer $(BOCl)_3(g)$ were presented as a result of a study of the reaction $B_2O_3(1) + BCl_3(g) = (BOCl)_3(g)$. Final calibrations and corrections yield definitive values for the heat of formation and entropy of $(BOCl)_3(g)$ at 298° K of -396.7 ± 2 kcal/mole and 92.5 ± 2 cal/deg/mole, respectively. Work is also described concerning the study of the reaction $1/3B_2O_3(1) + 1/3BCl_3(g) = BOCl(g)$ by a method of effusion. Preliminary experimental results of this low-pressure, high-temperature study indicate a heat formation for BOCl(g) at 1279° K of -76.3 kcal/mole as determined by the Third-Law method. Author

N63-16596 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio
HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 22, PART A, JANUARY 1, 1963-MARCH 15, 1963
Apr. 30, 1963 24 p 5 refs
(Contract AT(40-1)-2847)
(GEMP-22A) OTS: $0.50

Activities included studies of planar type of preferred orientation, microscopic examination of helium bubbles, and measurements of the radiation expansion, thermal expansion, and strength of specimens of the grain size–density series. In randomly oriented material, expansion of specimens with grain sizes of 5-, 10-, 20-, and 50-microns in 100° C irradiations follows the trend of smaller expansion as grain size decreased. In the UOX-MgO composition, the expansion follows a trend consistent with the extent of preferred orientation. Specimens containing 75 percent or more preferred orientation showed a remarkable reduction of expansion at 100° C, but the reduction did not persist at irradiation temperatures of 300° to 600° C. The thermal expansion behavior of BeO does not appear to be changed in specimens irradiated at elevated temperatures or in thermally annealed specimens. Author

N63-16681 Space Technology Labs., Inc., Redondo Beach, Calif.
BOSON EIGENSTATES IN GENERALIZED FIELD THEORY
H. C. Corben [1963] 7 p 3 refs
(Supported in part by ONR)

Algebraic expressions are given for the energy levels representing the eigenstates of a Hamiltonian defined in a given equation. A complete rest-energy eigenstate listing for particles having spin states from 0 to 2 and a charge of 1 is given. Also, predictions are made that the spin state of the zeta-particle is unity and the spin of the $f^{(0)}$ is 2, the highest resonance observed by Shalamov and Grashin would have spin 2, and the second highest would have a mixture of spin 1 and spin 0 states. D.E.R.

N63-16685 Cryogenic Engineering Lab., National Bureau of Standards, Boulder, Colo.

THE SPECIFIC HEAT AT CONSTANT VOLUME OF *PARA*-HYDROGEN AT TEMPERATURES FROM 15 TO 90° K AND PRESSURES TO 340 atm

B. A. Younglove and D. E. Diller Repr. from Cryogenics, v. 2, no. 6, Dec. 1962 p 1–5 8 refs
(NASA Order R-45)
(NBS-R-270; NASA-CR-50187)

The computation of the thermodynamic properties, relative to that of an ideal gas, of a compressed fluid by means of the equation of state requires that the data be extremely accurate. The uncertainties that are introduced through the derivatives of the equation of state would be minimized by supplementing the calculations with the constant volume specific heat data of the compressed fluid. With this in mind, calorimetric specific heat measurements were made of *para*-hydrogen at constant volume of the compressed fluid from well below, to above, the critical temperature. I.v.L.

N63-16686 California Inst. of Tech. Quantum Electronics Lab., Pasadena

MULTI-REFLECTOR OPTICAL RESONATORS Scientific Report No. 3

Peter O. Clark Apr. 10, 1963 8 p 9 refs
(Contract AF 19(604)-8052)
(AFCRL-63-115)

An analysis of multireflector optical resonators based on geometrical optics is presented, and the conditions for stable operation of these devices are determined. A four-mirror system which uses spherical reflectors 1 and 1' with a radius of curvature b_1 and reflectors 2 and 2' with radius of curvature b_2 is considered. The geometrical optics of such a system are treated in a manner similar to that of Pierce (1954) and Boyd and Kogelnik (1962). The symmetry of the resonator allows the path of a ray to be described by four difference equations whose approximate solution leads directly to a linear, homogeneous difference equation for the stability condition. The reductions of this stability equation for the rhomboidal resonator and for the rectangular resonator are presented. This analysis is applicable to optical masers with four-mirror cavities, ring lasers, and mode selection in toroidal ruby lasers. M.P.G.

N63-16687 Cryogenic Engineering Lab., National Bureau of Standards, Boulder, Colo.

THE SPECIFIC HEAT OF SATURATED LIQUID *PARA*-HYDROGEN FROM 15 TO 32° K

B. A. Younglove and D. E. Diller Repr. from Cryogenics, v. 2, no. 5, Sept. 1962 p 1–5 16 refs
(NASA Order R-45)
(NBS-R-269; NASA-CR-50186)

The specific heat of saturated liquid *para*-hydrogen C_σ was measured by means of a calorimeter cryostat in the light of determining the thermodynamic properties of *para*-hydrogen at high densities and low temperatures. The thermodynamic properties of the compressed liquid were computed using C_σ as the baseline. Also, the specific heat of argon was measured. Results obtained in these investigations were compared with those from other sources for the purpose of evaluating the accuracy that may be expected in future measurements of compressed fluids using this calorimeter cryostat. I.v.L.

N63-16698 Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge

HIGH-DIELECTRIC-CONSTANT MATERIALS AND FERROELECTRICITY Final Report

A. von Hippel et al Mar. 1963 86 p 76 refs
(Contract AF 19(604)-6155)
(MIT-TR-178; AFCRL-63-92)

This final report presents the advances made during a three years' study in: theoretical understanding of the onset and frequency response of ferroelectricity; techniques of growing single crystals and preparing ceramics of reproducible properties; chemical analysis and synthesis of high-dielectric-constant materials; effects of cation substitution; measurement techniques; and the interpretation of optical and electric spectra and conduction phenomena. Author

N63-16721 Vermont U., Burlington

WORK FUNCTION CHANGES PRODUCED BY CHEMISORPTION ON SURFACES WITH DIFFERENT TYPES OF ADSORPTION SITES

A. D. Crowell and A. L. Norberg, Jr. Repr. from J. Chem. Phys., v. 37, no. 4, Aug. 15, 1962 p 714–717 15 refs
(NASA Grant NsG-241-62)
(NASA CR-50027)

A simple model describing the changes in work function produced by chemisorption on a surface possessing two types of adsorption sites is presented. Equations for the change in work function as a function of the amount of gas adsorbed are given, and curves for the cases of CO and N_2 adsorbed on the (113) plane of tungsten are compared with recent experimental results. Author

N63-16725 Northeastern U., Boston, Mass.

STUDY AND INVESTIGATION OF SPEECH DATA Final Report, Mar. 15, 1962–Mar. 14, 1963

L. Dolansky, J. T. Barrs, C. R. Howard, and C. Karis Mar. 15, 1963 64 p 24 refs
(Contract AF 19(628)-389)
(AFCRL-63-118)

Speech signals processed by a Vocoder and the Digital Voice Data Processing System have been compared with clear-speech signals by means of intelligibility tests; the quantitative intelligibility degradation was measured under various conditions of Vocoder voicing, using varying numbers of quantizing levels for the reproduced signals. It was found that (1) The major decrease of intelligibility was attributable to the Vocoder processing. (2) The reduction of the number of quantizing levels had some effect upon listener confidence, but no noticeable effect upon intelligibility. (3) Erroneous voiced responses to unvoiced sounds, processed by the Vocoder, could be eliminated in many cases by a suppresion of the fricative-vowel transition region. (4) The elimination of the beginning part of initial voiceless fricatives in clear speech resulted in responses corresponding to other consonants, most frequently to voiced stops. Author

N63-16798 Doucette (E. I.) Associates, Inc., Chatham, N.J.

A QUANTITATIVE STUDY OF THE EVOLUTION OF GASES FROM ELECTRON TUBES AND MATERIALS Fourth Scientific Report, Sept. 18, 1962–Dec. 18, 1962

W. J. Grubbs, G. H. Snider, and F. I. Scott Jan. 31, 1963 43 p 3 refs
(Contract AF 19(628)-326)
(AFCRL-63-35)

A bakeable, ultra-clean high-vacuum system, which incorporates an omegatron mass spectrometer, has been constructed for conducting these investigations. During this period, several Amperex Type-5894 tubes have been degassed by various schedules. The pumping speed of the ion pump was estimated for methane gas. Several difficulties with heating and operating the tube under test were resolved. The principal gas evolved during d.c. bombardment of this tube is hydrogen. Author

N63-16824 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionali, Frascati (Italy)
MEASUREMENT OF THE HEIGHT OF THE MAGNETIC FIELD BY MEANS OF THE FARADAY EFFECT (LA MISURA DI ALTI CAMPI MAGNETICI MEDIANTE L'EFFETTO FARADAY)
A. Bonanni and G. Sacerdoti Jan. 22, 1963 20 p 16 refs In ITALIAN
(Its Nota interna 182; LNF-63/3)

A description of the instrumentation for the measurement of high pulsating fields by using the Faraday Effect is given. The sensitivity of the measure is proportional to the magnetic field. The resolved power is on the order of 0.22 Webers per square meter per impulse. The precision of the measurement is of the same order as the sensitivity of the instrumentation if the temperature of the probe is known and the Verdet constant at the same temperature is applied. Trans. by P.F.E.

N63-16846 National Research Council. Nuclear Data Group, Washington, D.C.
NUCLEAR THEORY REFERENCE BOOK FOR 1957 AND 1958. COMPILATION OF NUCLEAR THEORY INDEX CARDS
J. B. Marion (Maryland U.) ed., P. Marmier (Eidgen. Tech. Hochschule), and R. Van Lieshout (Inst. Kernphys. Onderzoek) Apr. 1963 142 p 1276 refs
(Supported by AEC)
GPO: $1.00

A guide to theoretical papers on nuclear-structure physics, formerly issued on cards, is published here in book form. Subjects covered are: nuclear structure, nuclear models, nuclear properties and reactions, electromagnetic radiation, beta decay and parity, alpha decay, tables and special topics, and an author index. D.E.R.

N63-16847 National Research Council. Nuclear Data Group, Washington, D.C.
NUCLEAR THEORY REFERENCE BOOK FOR 1959 AND 1960. COMPILATION OF NUCLEAR THEORY INDEX CARDS
J. B. Marion (Maryland U.) and R. Nakasima, eds., P. Marmier and E. Sheldon (Eid-Onderzoek) Apr. 1963 158 p 1415 refs
(Supported by AEC)
GPO: $1.00

This guide to theoretical papers on nuclear-structure physics covers nuclear models, nuclear properties, nuclear reactions, electromagnetic radiation, beta decay and parity, and alpha decay. Previous volumes were issued on cards rather than in book form. J.A.J.

N63-16850 Atomic Energy Commission. New York Operations Office. Health and Safety Lab., N.Y.
ENERGY DEPENDENCE DETERMINATIONS IN THE 60-180 KeV RANGE WITH AN X-RAY MACHINE OF VARYING OUTPUT
Arthur Shambon, Albert Zila, and Robert Sanna Washington, AEC Div. of Technical Information, Feb. 1963 32 p 9 refs
(HASL-133) OTS: $0.75

Adequate energy dependence calibrations of a Victoreen Cavity Chamber were achieved at HASL utilizing filtered beams from a 250-kvp, Ox 250 General Electric pulsating industrial X-ray machine. Energy correction factors with errors under ±5% were obtained for energies of 63, 105, 150, and 180 Kev. These results compare favorably with NBS calibrations. The NBS errors are ±3%, using a constant potential X-ray machine. A description of the calibration facility, the equipment used, and the procedure developed is given. Author

N63-16869 Illinois U. Coordinated Science Lab., Urbana
ULTRAHIGH VACUUM: A SURVEY
D. Alpert Apr. 15, 1963 34 p 23 refs
(Contract DA-36-039-TR-US-AMC-02208(E))
(R-167)

Low-pressure measurement devices and instruments for producing high vacuums are reviewed and it is found that these two types of instrument systems are approximately equivalent to pressures down to 10^{-10} Torr. Two new classes of ionization instruments, sensitive to 10^{-11} Torr, for the measurement of total pressures and for the mass analysis of partial constituents as low as 10^{-16} Torr, are explained. The study of the physical and chemical processes occurring at 10^{-11} Torr is summarized and includes: the kinetics of gas surface interactions at the interface, the interaction of atomic particles, electrons and photons, with surfaces, and the nature of the electronic bonds between adsorbed molecules and surfaces. D.E.R.

N63-16902 Lockheed Missiles and Space Co., Sunnyvale, Calif.
DIFFRACTION PATTERN ANALYSIS OF A RECTANGULAR APERTURE IN THE PRESENCE OF ABERRATIONS. PART 2: THE DIFFRACTION PATTERN IN THE PRESENCE OF SINGLE THIRD-ORDER ABERRATIONS: I. THE EFFECT OF PRIMARY ASTIGMATISM Technical Report: Communications
H. P. Greinel May 1963 28 p 2 refs
(LMSC-6-90-63-23)

On the basis of the general solution of the diffraction integral for a rectangular aperture in the presence of geometrical-optical aberrations, this paper deals with the effect of primary astigmatism upon the diffraction-pattern intensity distribution. The diffraction pattern of a stationary rectangular aperture is described by means of a conveniently chosen Cartesian reference system. We consider two orthogonal aperture orientations, and show that the intensity distribution depends on the orientation of the aperture's symmetry axes with respect to the meridional plane defined by the optical axis and the geometrical image point. The intensity distributions in special cases of interest are indicated for each of the two aperture orientations. In the case of a slit rotating about the center of the entrance-pupil plane, i.e., in the case of arbitrary slit orientation with respect to the meridional plane, the Cartesian reference system is one which rotates synchronously with the aperture. We derive a general expression for the diffraction-pattern intensity distribution in this rotating coordinate system, and obtain its mean value throughout half a slit revolution by integration. Again we indicate special cases of interest. Finally, we determine the overall diffraction-pattern intensity distribution of the rotating aperture with respect to a space-fixed coordinate system. The accumulated intensity at any arbitrary point of a space-fixed observation plane, as experienced for example, by a photographic plate, may be obtained by integration. Author

N63-16927 Navy Electronics Lab., San Diego, Calif.
A COLOR CONVERSION TECHNIQUE FOR ELECTROLUMINESCENT LIGHT
R. B. Nehrich, Jr. and R. K. Logan July 6, 1962 26 p 10 refs
(NEL-1121; AD-278747)

Color conversion filters have been developed for obtaining electroluminescent lighting from any basic blue or green light. This lighting is needed for the improvement of reliability and maintainability of systems and instrumentation requiring illuminated indicators, readouts, or displays. C.L.W.

N63-16946 Comitato Nazionale per l'Energia Nucleare. Lab. Nazionale Frascati (Italy)
A MAGNET FOR A DIFFUSER [MAGNETE PER CAMERA A DIFFUSIONE]
R. Garfagnini, G. Piragino (Turin U.), G. Sacerdoti Jan. 28, 1963 13 p 5 refs In ITALIAN
(*Its* Nota Interna 183; LNF-63/4)

A magnetic analyzer for a diffusion chamber at the University of Turin is described. The useful volume of the chamber is in the shape of a cylinder, with a diameter of 36 cm and height, 8 cm. Pertinent data for the magnet is as follows: height of the gap, 78 cm; internal diameter of the coil, 60 cm; distance between coils, 21 cm; number of turns on each coil, 156; maximum current, 2000 amperes; and maximum field, 0.9 Webers per square meter. Trans. by P.F.E.

N63-16951 Bettis Atomic Power Lab., Westinghouse Electric Corp., Pittsburgh, Pa.
TIME-DEPENDENT FISSION-PRODUCT THERMAL AND RESONANCE ABSORPTION CROSS SECTIONS
T. R. England Nov. 1962 67 p 15 refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-333) OTS: $1.75

An exact analytical method is outlined by which the detailed time-dependent concentration of each fission product and other generated nuclides can be calculated. Radioactive decay and neutron absorption in the time-dependent reactor flux are explicitly included. In addition to U^{235} several fissile nuclides may simultaneously provide a source to the fragment concentrations. The method is demonstrated by calculating both the individual and total thermal and resonance cross sections per fission of 163 fission products from U^{235}, natural uranium, enriched uranium, and Pu^{239} in a variety of irradiation flux histories and spectra. All known fission products of significance, i.e., those formed by direct fission yields and their progeny formed by neutron absorption and radioactive decay, are included in the analysis. This is in contrast to treatments which have largely ignored coupling systematics. A comparison of the aggregate absorption cross sections, determined by both calculation and experiment for a highly enriched sample, which has been irradiated in the MTR to 81 percent U^{235} depletion, shows agreement within 2 percent thermally and 15 percent epithermally. Author

N63-16978 Bureau of Mines. College Park Metallurgy Research Center, Md.
X-RAY MASS ABSORPTION COEFFICIENTS A Literature Survey
Howard M. Stainer 1963 130 p 28 refs
(BM-IC-8166)

Published X-ray mass absorption coefficients were compiled and tabulated. These coefficients are required for various X-ray analytical techniques. Values obtained from 28 authors are listed for 87 elements, with both experimental and calculated points included; the wavelengths range from ~0.01 to 68 A. Representative graphs are presented for six elements (lithium, nitrogen, iron, silver, holmium, and uranium. A 37-item supplementary bibliography is also included. Author

N63-16982 Calif. Inst. of Tech. Chemical Engineering Lab., Pasadena
STRUCTURE OF LIQUIDS Final Report
Cornelius J. Pings Mar. 23, 1962 12 p 8 refs
(Contract AF 49(638)-800)
(MS-10039-M)

CONTENTS:

Appendix A. BERYLLIUM SAMPLE CELL FOR X-RAY DIFFRACTION STUDY OF LIQUIDS H. H. Paalman (Stanford U.) and C. J. Pings Repr. from Rev. Sci. Instr., v. 33, no. 4, Apr. 1962 p 496–497 4 refs

Appendix B. NUMERICAL EVALUATION OF X-RAY ABSORPTION FACTORS FOR CYLINDRICAL SAMPLES AND ANNULAR SAMPLE CELLS H. H. Paalman (Stanford U.) and C. J. Pings Repr. from J. Appl. Phys., v. 33, no. 8, Aug. 1962 p 2635–2639

Appendix C. STRUCTURE OF LIQUID NITROGEN H. H. Paalman (Stanford U.) and C. J. Pings Repr. from Molecular Phys., v. 5, no. 5, Sept. 1962 p 521 13 refs

24 PHYSICS, PLASMA

Includes: fusion; and magnetohydrodynamics.

For related information see: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N63-16384 Wisconsin U., Madison
THE ELASTODYNAMICS OF MOVING LOADS. PART II: THE STRESS AND VELOCITY FIELD OF AN ENERGY SOURCE MOVING IN AN ELASTIC SOLID WITH A FREE SURFACE AT CONSTANT VELOCITY Technical Summary Report
Michael Papadopoulos May 1962 32 p 5 refs
(Contract DA-11-022-ORD-2059)
(MRC-311)

This paper is principally concerned with the determination of the dynamic fields associated with the setting-up of so-called strain nuclei in an isotropic elastic solid. This is done with particular emphasis on representation in the form of integral superpositions of singular plane waves. The calculations give the dynamic field within an infinite solid in a general form which is valid for any constant velocity of the energy source, and since the expressions found are given in plane-wave form, more complicated problems of elastodynamics which involve plane boundaries are particularly easy to investigate. The particular case of an infinite solid with a free plane surface is examined along with the cases of a buried moving source and a surface moving source. The formulae for dilatation and for shear potentials are established. Author

N63-16388 Naval Research Lab., Washington, D.C.
A MODIFICATION OF THE IONIZATION METHOD ESPECIALLY SUITABLE FOR CONTINUOUSLY RECORDING CONTACT POTENTIAL DIFFERENCES
K. Bewig Apr. 11, 1963 8 p 11 refs
(NRL-5915) OTS: $0.50

A study was made of the factors which minimize the inherent errors of the ionization method and of a modification which permits the use of an ordinary low-impedance-input d.c. chart-type voltmeter and the use of a wide air spacing desirable

for certain applications. The modification is an accounting for errors introduced by a wide spacing between the ionizing source and the surface being studied, the wide spacing causing the air-space impedance to be comparable to the impedance of the indicating meter. In comparing the vibrating condenser method and the ionization method, it was determined that in those cases where gaseous adsorption is not a factor the ionization method did show much greater sensitivity as well as permit continuous d.c. voltmeter recording. Author

N63-16391 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VARIATIONAL APPROACH TO THE CALCULATION OF CHARGE EXCHANGE CROSS SECTIONS FOR ADIABATIC COLLISIONS
Frederick E. Alzofon and Fred C. Witteborn Washington, NASA, May 1963 11 p 6 refs
(NASA TN-D-1654) OTS: $0.50

Cross sections for the reaction $H^+ + H(1s) \rightarrow H(1s) + H^+$ are calculated for incident particle energies between 10 ev and 2250 ev using an impact parameter method. The required electronic energy levels were found by varying one parameter in the molecular ion wave function at every value of proton separation. The resulting cross sections are compared with those obtained using more accurate wave functions and with experimental data. Author

N63-16416 General Electric Co. Space Sciences Lab., King of Prussia, Pa.
INVESTIGATION OF NON-THERMAL IONIZATION FOR MHD ENERGY CONVERSION Quarterly Report No. 2, June 15-Sept. 15, 1962
George W. Sutton et al [1962] 66 p 24 refs
(Contract AF 33(657)-8289)

This report reviews two groups of experiments in cold cesium diodes. The first group of experiments cover cesium–helium discharge phenomena in a diode configuration and were made to verify theoretical concepts and formulations developed by Drs. D. J. BenDaniel, H. Hurwitz, and S. Tamor. The second group of experiments cover pure cesium discharges in a diode configuration and were conducted to answer questions concerning plasma conductivity, uniformity of discharge of the positive column, and the effect of wall conditions on the discharge. Also presented in this report is the preliminary design of a magnetohydrodynamic potassium vapor experiment. I.v.L.

N63-16436 Radio Corp. of America. Defense Electronic Products, Camden, N.J.
STUDY OF THE GENERATION OF COHERENT ELECTROMAGNETIC RADIATION BY A PULSATING PLASMA Final Report
R. E. Skinner Feb. 1963 75 p 13 refs
(Contract AF 30(602)-2510)
(RADC-TDR-63-135)

Coherent radiation from a plasma stimulated by a modulated electron beam at frequencies above the hybrid frequency has been observed, with electronic gains of more than 20 db. The measurements were made in the 3.95- to 5.85-gc region. The cyclotron frequency was 2.90 gc and the hybrid frequency was less than 3.18 gc. The experiment was performed with a cesium plasma. The experiments, their results, and the experimental facilities are described. The facilities consist of an extremely versatile, demountable, bakeable vacuum system with a magnet which produces a highly uniform field over the region occupied by the plasma. Author

N63-16446 Maryland U., College Park
COLLISION DAMPING OF PLASMA OSCILLATIONS I
David Gorman (Washington U., St. Louis) and David Montgomery [1962] 21 p 9 refs Submitted for Publication
NASA Grant NsG-220-62 and Grant NSF (G24834))
OTS: $2.60 ph, $0.83 mf

Collision damping of long-wavelength electrostatic oscillations in a high-temperature plasma is studied with the use of Guernsey's kinetic equation. A closed expression for $\gamma_C(k)$, the collision-damping decrement, is derived which is exact to first-order in the plasma parameter, k_D^3/n. Author

N63-16450 Boeing Scientific Research Labs. Flight Sciences Lab., Seattle, Wash.
THE EFFECTS OF HALL CURRENTS AND ASYMMETRIC INLET CONDITIONS IN INVISCID CONSTANT AREA CHANNEL FLOWS
Gordon C. Oates (M.I.T.) Jan. 1963 44 p 9 refs
(D1-82-0225)
(Flight Sciences Lab. Rept.-68)

This paper considers the effect of the Hall component of the current on the two-dimensional flow field of a nonviscous compressible fluid and investigates the perturbations which are introduced on purely axial flow. An equation for the perturbations in fluid properties is developed which gives the properties in terms of the imposed channel flow solution. Four examples are considered, three of which lead to closed form solutions. These closed form solutions are particularly suitable for interpretive purposes and, in fact, show that in some cases of high electromagnetic loading, the validity of the channel flow solutions will be quite restricted. Also, equations are solved for zero Hall current under assumed asymmetric inlet condition. This is the situation which could conceivably arise in an accelerator or generator with segmented electrodes when, for some reason, the inlet flow is perturbed. It was found that, in all cases investigated, such inlet perturbations grew to some extent within the machine. I.v.L.

N63-16457 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
CONSEQUENCES OF SYMMETRY IN PERIODIC STRUCTURES Research Report
P. J. Crepeau and P. R. Mc Isaac Feb. 15, 1963 45 p 9 refs
(Contract AF 19(604)-7499)
(PIBMRI-1113-63; AFCRL-63-104)

Periodic guiding or radiating structures at microwave frequencies frequently possess symmetry properties in addition to their axial periodicity. These include rotation and reflection symmetries, whether occurring alone or in conjunction with translations. These symmetries influence the characteristics of the electromagnetic fields associated with the structures. This paper shows that two symmetries, the screw and the glide, are particularly important in determining the characteristics of the fields. Some of the implications of these symmetries for leaky wave antennas and microwave tube interaction circuits are explored. The consequences of screw and glide symmetries, together with five other possible symmetries, are examined to facilitate the analysis and synthesis of periodic microwave structures. Author

N63-16467 Boeing Scientific Research Labs. Plasma Physics Lab., Seattle, Wash.
SOME EXACT SOLUTIONS FOR TWO-DIMENSIONAL HYDROMAGNETIC STEADY FLOWS
L. C. Levitt June 1962 32 p 3 refs
(D1-82-0170)

A study is presented of two symmetry types of planar hydromagnetic steady flows of a uniform, incompressible conducting fluid, moving under the influence of its own magnetic field. The motions considered are special cases of a fairly wide class of hydromagnetic flows exhibited by Lin. The equations-of-motion and induction, for both types, are formulated as nonlinear partial differential equations in a pair of stream functions, for the fluid velocity and magnetic field. Various general features of these flows are discussed, and a number of special exact solutions are derived for one of these types in unbounded space. In an appendix, a method is given by which the formulation of the infinite-conductivity cases is reducible to a single equation. Author

N63-16474 Aerospace Corp. Aerodynamics and Propulsion Research Lab., El Segundo, Calif.
SHOCK TUBE TEST TIME LIMITATION DUE TO TURBULENT WALL BOUNDARY LAYER
Harold Mirels May 6, 1963 59 p 16 refs
(Contract AF 04(695)-169)
(TDR-169(3230-12)TR-3; SSD-TDR-63-78)

Shock-tube test-time limitation due to the premature arrival of the contact surface is analytically investigated for wholly turbulent wall boundary layers. The results are compared with those for wholly laminar wall boundary layers. It is found that for a given shock Mach number, M_s, the maximum possible test time (in a long shock tube) varies as $d^{5/4}p_1^{1/4}$ and d^2p_1 for the turbulent and laminar cases, respectively (d = tube diam, p_1 = initial pressure). For $3 \leq M_s \leq 8$ in air or argon, it is found that the turbulent boundary layer theory for maximum test time applies for $dp_1 \gtrsim 4$ to 10 (air) and $dp_1 \gtrsim 2$ to 10 (argon), where d is in inches, p_1 is in cm Hg. Similarly, for $3 \leq M_s \leq 8$, the laminar theory applies for $dp_1 \lesssim 0.3$ (air) and $dp_1 \lesssim 0.6$ to 1 (argon). When $dp_1 \approx 5$, turbulent theory for both air and argon indicates test times of about 1/2 to 1/4 the ideal value for $x_s/d = 45$ to 150, respectively (x_s = length of low-pressure section). Higher values of dp_1 result in more test time. When $dp_1 \approx 0.5$, laminar theory indicates about 1/2 ideal test time for $x_s/d \approx 100$. Lower dp_1 reduces test time. Working curves are presented for more accurate estimates of test time in specific cases. Author

N63-16478 University of Southern Calif., Los Angeles
THE KINETIC THEORY OF WAVES IN A WARM PLASMA EXCITED BY A CURRENT SOURCE Technical Report
Hans H. Kuehl Dec. 1962 20 p 6 refs
(Contract AF 19(604)-6195)
(AFCRL-62-970; USCEC-82-208; EE-18)

The general expression for the electromagnetic field due to an arbitrary monochromatic current source in an unbounded, warm, homogeneous plasma in the absence of a magnetostatic field is derived. The linearized Boltzmann equation with a simple relaxation collision term is used and the ion motion is neglected. The result is specialized to the case of an electric dipole source which is compared to the result obtained from the hydrodynamic equations. It is found that, except for Landau damping, the two methods agree provided the frequency of the dipole is near the plasma frequency. Author

N63-16503 California U., Berkeley. Lawrence Radiation Lab.
FORMATION OF ENERGETIC FRAGMENT IONS BY BOMBARDMENT OF ORGANIC MOLECULES WITH SLOW ELECTRONS
John A. Olmsted (Ph.D. Thesis) Feb. 18, 1963 135 p 53 refs
(Contract W-7405-eng-48)
(UCRL-10687) OTS: $2.50

Excess-kinetic-energy fragment ions resulting from the bombardment of organic molecules with 0- to 100-volt electrons have been studied by using the techniques of mass spectrometry. The effects on such ions of variations in the mass-spectrometer operating conditions have been determined. The excess kinetic energies possessed by both near-thermal and excess-kinetic-energy methyl ions have been measured for a large number of organic compounds, and it is found that most "thermal" methyl ions have about 0.3 ev excess kinetic energy. Energies measured for excess-kinetic-energy methyl ions are in agreement with those determined by other experimenters, if the latter values are corrected by the addition of the excess kinetic energies of the near-thermal methyl ions. Author

N63-16505 California U., Berkeley. Lawrence Radiation Lab.
APPARENT HORIZONTAL SOURCE POSITIONS AND EXIT DIRECTIONS FOR NEGATIVE SECONDARY BEAMS FROM THE BEVATRON
Peter M. Goorjian Mar. 19, 1963 17 p 2 refs
(Contract W-7405-eng-48)
(UCRL-10705) OTS: $0.50

An explanation is presented for using the three "Source Maps" referring, respectively, to current markers 26, 29, and 33. These maps determine the apparent horizontal source position and exit path for any beams traveling in the median plane, which can emerge from an internal Bevatron target with a zero degree production angle. This information can be obtained in a few seconds using a straightedge. The method of map construction is described, and the probable uncertainty in source location is discussed. The various target magnifications are presented. Author

N63-16509 Atomic Energy Commission, Bombay (India)
NEUTRON DOSIMETRY OF APSARA BY USING THERMAL AND THRESHOLD REACTIONS
K. S. Venkateswarlu, K. R. Ramaprasad, Ramendra Shanker, Manohar Lal, V. Subramanyam, and M. G. Sane 1963 18 p 5 refs
(AEET-CD-10)

Utilizing cobalt, iron and ferrous ammonium sulfate as the dosimeters, the thermal neutron fluxes at various positions and the fast neutron spectrum at the high flux positions in Apsara were completely mapped. From the studies, the versatility of ferrous ammonium sulfate as a complete neutron dosimeter was shown. It ensures a simple, quick, and reasonably accurate method, avoiding complicated instrumentation, and remains active long after irradiation, making immediate measurement of the neutron dose unnecessary. C.L.W.

N63-16512 Warner and Swasey Co., Flushing, N.Y.
INFRARED SPECTRA AND TEMPERATURES OF PLASMA-JETS: SPECTROMETRIC AND SPECTRORADIOMETRIC MEASUREMENTS OF PLASMAJET TEMPERATURE DISTRIBUTIONS [Interim Technical Report]
Lowell R. Ryan, Harold J. Babrov, and Richard H. Tourin Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Feb. 1963 44 p 19 refs
(Contract AF 33(616)-8057)
(ARL-63-35)

Temperatures of plasmajets were measured by several optical methods, and the results intercompared. Both spectrometric and spectrororadiometric methods were used. Argon and nitrogen plasma jet temperatures were studied in particular detail. Large temperature gradients were observed in all the plasmajets studied. A considerable amount of infrared absorptance was observed in

a nonluminous region surrounding the visible plasmajet. Argon plasmajet temperatures ranged from 14,300° K down to 8000° K in the visible plasmajet, and from 8000° K to as low as 3000° K in the nonluminous zone. Nitrogen plasmajet temperatures ranged from less than 6000° K to 10,950° K on the axis. In an argon-seeded nitrogen plasma, close agreement was obtained between temperatures determined from the line intensities of atomic nitrogen and argon. The temperature from the argon line was based on an absolute intensity measurement, whereas the relative intensities of the nitrogen lines (Boltzmann plot) were used to determine the nitrogen temperature. Author

N63-16519 RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND TIME-DEPENDENT SCATTERING OF LIGHT IN A ONE-DIMENSIONAL MEDIUM
Richard Bellman, Robert Kalaba, and Sueo Ueno May 1963 20 p 12 refs
(ARPA SD-79; ARPA Order 189-61)
(RM-3603-ARPA)

By means of the invariant-imbedding technique, the integral equations for the reflection and transmission coefficients of radiation in a one-dimensional medium are obtained, allowing for the release of absorbed energy with a random time delay. Furthermore, the reflected and transmitted intensities for the fluorescence problem in a one-dimensional medium are expressed in terms of these coefficients, assuming no distribution of emitting sources in the medium. Author

N63-16523 Laboratoire de Physique Théorique et des Hautes Énergies, Orsay (France)
PERTURBATION EXPANSION WITHIN UNITARY SYMMETRY
Jean Ginibre May 1963 30 p 13 refs

The number of parameters which occur in perturbation expansions of masses and electromagnetic quantities within unitary symmetry is calculated. The contributions of the various irreducible parts in the second-order mass formula are then separated and properly normalized, which allows a comparison of the relative magnitude of the different orders of perturbation in the physically interesting cases. Author

N63-16548 Lockheed-Georgia Co., Marietta
EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES Quarterly Progress Report No. 7, July 1962 through Sept. 1962
[1962] 42 p
(NASA Contract NASw-114)
(ER-6047; NASA-CR-50056) OTS: $4.60 ph, $1.46 mf

This report provides a summary of temperature-measuring techniques in addition to the activities relevant to installation of test equipment at the Plum Brook Reactor Facility. Author

N63-16565 California U., Livermore. Lawrence Radiation Lab.
AN INTERACTION BETWEEN A PLASMA AND A TRAVELING MAGNETIC DISTURBANCE
Daryl D. Reagan Feb. 25, 1963 14 p 3 refs
(Contract W-7405-eng-48)
(UCRL-7253) OTS: $0.50

A traveling-wave disturbance can move in the direction parallel to an axial magnetic field in a hot cylindrical plasma, producing sinusoidal compression and expansion. Approximate equations are derived, which govern the "perpendicular" and "parallel" temperatures, density, and axial drift speeds of the electrons and ions, and the induced axial electric field in such a disturbed plasma. The treatment is restricted to disturbance frequencies which are well below the cyclotron and plasma frequencies. Collision terms involving electron–electron, electron–ion, and ion–ion encounters are evaluated. It is shown that the plasma mass motion can have both longitudinal and transverse components. Author

N63-16588 General Electric Co. Space Sciences Lab., King of Prussia, Pa.
THEORETICAL PERFORMANCE FOR MHD GENERATORS UTILIZING NON-EQUILIBRIUM IONIZATION IN PURE ALKALI METAL VAPOR SYSTEMS
F. H. Shair and F. Christinzio Jan. 1963 63 p 11 refs
(Contract AF 33(657)-8298)
(R62SD94)

Each member of the alkali metal series has been investigated to determine the best system for a closed-cycle MHD generator utilizing magnetically induced nonequilibrium ionization. MHD generator performances have been calculated for one-dimensional steady-state flows with constant Mach number in which the dimer concentration is neglected. The calculations are for a generator with segmented electrodes. Potassium appears to be the best choice among the alkali metal series for a 1-megawatt generator operating at total temperatures near 1600° K and total pressures around 20 psia. The calculations show that the performance of an MHD generator utilizing a nonequilibrium condition of the electrons is primarily dominated by the elastic electron-neutral collision cross section. Author

N63-16595 Aeronutronic, Newport Beach, Calif.
INFRARED TRANSMISSION STUDIES. VOLUME IV: THE INFLUENCE OF NUMEROUS WEAK LINES ON THE ABSORPTANCE OF A SPECTRAL BAND Final Report
G. N. Plass Apr. 12, 1963 27 p 14 refs
(Contract AF 04(695)-96)
(SSD-TDR-62-127, Vol. IV)

The influence of numerous weak spectral lines on band absorption is investigated. It is shown that a region of validity always exists for the weak-line approximation. There is almost always also a region of validity for the strong-line approximation, unless the number of spectral lines increases very rapidly as the intensity approaches zero. The principal effects of the weak lines are to introduce points of inflection in the absorptance curves, and to increase the intermediate range of values of pressure and absorber concentration over which neither the strong- nor weak-line approximation is valid. These effects are illustrated by examples. From a study of the shape of experimentally determined absorptance curves, it is possible to deduce the number of weak lines in the frequency interval of interest. Author

N63-16599 Hughes Aircraft Co., Culver City, Calif.
RADIATION THROUGH CYLINDRICAL PLASMA SHEATHS Scientific Report No. 2
J. H. Harris Aug. 1962 50 p 7 refs
(Contract AF 19(604)-8386)
(AFCRL-62-976)

The problem considered is that of determining the radiation from a magnetic line source, axially oriented on a conducting cylinder when the cylinder lies in a plasma-sheath environment. The sheath is taken to be a series of homogeneous cylindrical layers, none of which is contiguous with the cylinder. Characteristics of the radiation field are discussed, and some radiation patterns are presented. The patterns are found to have large narrow-amplitude fluctuations that can be attributed to leaky waves. Author

N63-16679 Naval School of Aviation Medicine, Pensacola, Fla.
ENERGY DISSIPATION CHARACTERISTICS IN TISSUE FOR PROTON RADIATION IN SPACE. I. COMPARATIVE ANALYSIS OF THE LET SPECTRA OF MONOENERGETIC, FLARE PRODUCED, AND FISSION NEUTRON RECOIL PROTONS JOINT REPORT OF NASA AND NAVAL SCHOOL OF AVIATION MEDICINE
Hermann J. Schaefer Jan. 24, 1963 14 p 15 refs
(NASA Order R-75)
(Rept. 24; NASA-CR-50044) OTS: $1.60 ph, $0.80 mf

Based on the definition of local energy dissipation as produced by collisions transferring less than 100 ev, the LET spectra of flare produced and neutron recoil protons from thermal fission are established and compared to the corresponding spectrum of standard X-rays. A striking similarity is obtained between the spectra of flare protons and of X-rays whereas the recoil proton spectrum is basically different, centering heavily on LET values about and above 10 Kev/micron tissue. In the latter LET interval, flare protons dissipate only a few percent of their total energy. This indicates that the bulk of the ionization dosage from flare protons should be assigned the RBE of 1.0 with only a fraction requiring elevated RBE values. Author

N63-16691 Nihon U. Coll. of Science and Engineering, Tokyo (Japan)
MEISSNER EFFECT AND THE SELF-ENERGY OF THE PHOTON
Osamu Hara [1962] 27 p 19 refs
(NUP-63-4)

A close analogy exists between the Meissner effect of the superconductor and the self-energy of the photon. Based on this analogy, it is shown that a gage invariant self-energy can be obtained by introducing the contributions from the collective motion of the vacuum electrons, just as the gage invariant theory of the Meissner effect can be obtained by introducing the contribution from the plasma oscillation. Some implications of the nonvanishing self-energy are discussed. Author

N63-16711 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
DISPERSION AND DAMPING OF LONGITUDINAL ELECTRON OSCILLATIONS IN THERMAL PLASMAS
James F. Morris Washington, NASA, June 1963 58 p 25 refs
(NASA TN-D-1734) OTS: $1.50

Approximate frequencies and damping factors computed for longitudinal electron oscillations in classical and quantum thermal plasmas are presented; effects of some major assumptions on the values of dispersion variables are discussed. These and some other simple, incidental characteristics of plasmas are tabulated for electron number densities from 10^3 to 10^{24} per cubic centimeter, temperatures from near the "degeneracy" level to 10^{7}° K, and wavelengths from about 1 to 10^5 times the Debye distance. Author

N63-16729 Sylvania Electric Products, Inc. Applied Research Lab., Waltham, Mass.
A STUDY OF EXTREMELY-LOW-FREQUENCY WAVE MOTIONS Scientific Report No. 1
A. Cantor and J. Farber Apr. 30, 1963 133 p 13 refs
(Contract AF 19(628)-340)
(AFCRL-63-491)

This report is concerned with a proper treatment of disturbances in the ionosphere. It develops the treatment of the excitation of extra-low-frequency (magnetohydrodynamic-like) wave-motions in an infinite, homogeneous plasma imbedded in a constant, unidirectional magnetic field, for which the electrical conductivity tensor is easily established and methods of analysis are highly developed. Author

N63-16734 College of William and Mary, Williamsburg, Va.
SOME CONSIDERATIONS OF AN AXIAL ARC IN A RADIAL MAGNETIC FIELD
Philip Brockman (M.A. Thesis) May 1963 45 p 13 refs

Hall currents have been measured in the linear Hall accelerator at pressures from 15 to 40 microns of mercury, in argon, at currents from 10 to 40 amps, at voltages from 100 to 600 volts, and at magnetic-field strengths from 12.5 to 550 gauss. Hall current at constant axial current shows an increase to a maximum and a subsequent decrease with increasing magnetic-field strength. A tentative theory based on the increase of ion slip with increasing magnetic-field strength is proposed, and agreement is shown. Author

N63-16778 Rochester U., N.Y.
A NO INTERACTION THEOREM IN CLASSICAL RELATIVISTIC HAMILTONIAN PARTICLE DYNAMICS
John T. Cannon (Antioch Coll.) and Thomas F. Jordan May 8, 1963 38 p 4 refs
(Contract AT(30-1)-875)
(NYO-10263)

It is shown that a relativistically invariant classical mechanical Hamiltonian description of a system of three (spinless) particles admits no interaction between the particles. If a set of ten functions of the canonical variables of the three-particle system satisfies the Poisson bracket relations characteristic of the ten generators of the inhomogeneous Lorentz group, and, with the canonical position variables of the particles, satisfies the Poisson bracket equations which express the familiar transformation properties of the (time-dependent) particle positions under space translation, space rotation, and Lorentz transformation, then this set of ten functions can only describe a system of three free particles. A significant part of the proof is valid for a system containing any fixed number of particles. In this general case, a simplified form is established for the Hamiltonian and generators of Lorentz transformations, and it is shown that the generators of space translations and space rotations can be put in the standard form characteristic of free-particle theories. The proof of the latter involves a generalization from one to many three-vector variables of the angular momentum Helmholtz theorem of Lomont, Moses, and Keller. Author

N63-16781 Illinois U., Urbana
EXPERIMENTAL STUDY OF THERMAL ELECTRIFICATION OF A GAS-SOLID SYSTEM
S. L. Soo and R. C. Dimick Charlottesville, Va. U. School of Eng. and Applied Sci., Apr. 1963 21 p 6 refs For Presentation at the Symp. on Multi-Component Multi-Phase Flows, Nov. 1963
(Contract Nonr-3623(00); Proj. Squid)
(ILL-11-P)

A preliminary experimental study was carried out on the thermal electrification of a gas–solid system and removal of electrons from an ionized gas by charged solid particles. Author

N63-16790 Brown Engineering Co., Inc., Huntsville, Ala.
REFLECTION AND TRANSMISSION COEFFICIENTS FOR A PLASMA LAYER
J. M. Scarborough Apr. 1963 20 p 2 refs
(Contract DA-01-009-ORD-1019)
(Tech. Note R-46)

Reflection and transmission coefficients are computed for a plane electromagnetic wave incident normally on a plane-parallel layer of uniform lossy plasma of finite thickness. Results are expressed in dimensionless form in order to extend their range of applicability. It is found that for layer thicknesses small compared to the wavelength, transmission should be appreciable even at frequencies below the plasma frequency. Author

N63-16875 Lincoln Lab., Mass. Inst. of Tech., Lexington
SCATTERING FROM DENSITY FLUCTUATIONS IN A PLASMA (SCATTERING AND ABSORPTION CROSS SECTION) Technical Report
M. S. Macrakis Oct. 22, 1962 21 p 8 refs
(Contract AF 19(628)-500)
(Tech. Rept. 284; AFESD-TDR-62-249; AD-291779)

This report generalizes the formulation of the scattering problem to show that the absorption cross section must be considered in addition to the scattering cross section. The formulation of the problem follows two different but equivalent methods. One method depends on the connection between the scattering cross section and the imaginary part of the index of refraction. The second method depends on the use of Boltzmann's equation for the description of a plasma in terms of a dielectric with spatial dispersion and external (free) charges and currents. The work indicates that a correct description of the problem requires the use of the space and time-dispersive dielectric coefficients $\epsilon^{trans}(k\omega)$ and $\epsilon^{long}(k\omega)$. In addition to the transverse scattering cross section, the cross section is derived for scattering of a coherent, longitudinal density wave from density fluctuations. Author

N63-16877 Cornell U., Ithaca, N.Y.
ON THE MOTION OF A SPHERE THROUGH A CONDUCTING LIQUID IN THE PRESENCE OF A MAGNETIC FIELD Technical Report No. 2
G. S. S. Ludford and M. P. Singh July 1962 21 p 5 refs
(Contract Nonr-401 (46); NSF Grant 19911)

This review on the motion of a sphere through a conducting liquid in the presence of a magnetic field includes: (1) a discussion of the errors in Stewartson's analysis of this motion and (2) the development and solution of a method for the case of a sphere moving along the magnetic lines of force. This method, which is applicable to both conducting and nonconducting spheres, is based on the compression of the coordinates along the magnetic field as time goes to infinity so as to retain the undisturbed conditions at infinite distances. I.v.L.

N63-16879 California U., Berkeley. Inst. of Engineering Research
A SPECTROSCOPIC STUDY OF RECOMBINATION IN A HELIUM PLASMA
F. A. Robben Apr. 5, 1963 52 p 23 refs
(Contract AF 49(638)-502)
(HE-150-211)

By making absolute intensity measurements of all the lines of helium emitted from the decaying plasma of an arc jet in the visible and near ultraviolet, the number densities of the excited states of helium have been calculated. When interpreted by means of the collisional-radiative recombination model, these measurements give values for $K_{n,n-1}$, the collisional de-excitation rate constant of an excited helium atom from level n to n-1. The constancy of $K_{n,n-1}$ over a range of electron density from 4×10^{12} to 4×10^{14} per cm^3 indicates the validity of the model, and the values of $K_{n,n-1}$ are in reasonable agreement with a recent theory of classical excitation cross sections. Author

N63-16914 Cruft Lab., Harvard U., Cambridge, Mass.
EXCITATION OF PLASMA WAVES IN AN UNBOUNDED HOMOGENEOUS PLASMA BY A LINE SOURCE
S. R. Seshadri July 23, 1962 42 p 7 refs
(Contract Nonr-1866(32); NSF Grant 9721)
(Tech. Rept. 373; AD-283830)

The radiation characteristics of a line source of magnetic current embedded in a homogeneous electron plasma of infinite extent are investigated for the case in which a uniform magnetic field is impressed externally throughout the medium in the direction of the source. The single-fluid theory of magnetohydrodynamics is employed. A very simple model is assumed for the plasma. Under this assumption, it is found that there are two modes of propagation of waves of small amplitude. By examining the behavior of these modes in the limiting cases of vanishing external magnetic field or finite-source frequency, they are identifiable as the modified forms of the usual plasma and optical modes which exist in an isotropic electron plasma. The dispersion relations for these two modes are discussed. The power radiated in each of the two modes is also evaluated. It is found that the power radiated in the optical mode is always lower than that due to the line source in free space, whereas the power radiated in the plasma mode is higher than that value for certain ranges of the source frequency. Author

N63-16917 Toronto U. Inst. of Aerophysics (Canada)
RESEARCH IN MAGNETOGASDYNAMICS Final Technical Report
J. H. deLeeuw Mar. 28, 1962 14 p 5 refs
(Contract AF 49(638)-823)
(AD-283026)

The flow of ionized gases is being studied with the particular purpose of considering the influence of electric and magnetic fields on the flow characteristics. Both steady plasma flows and the ionized gas flows produced in magnetically driven and conventional shock tubes are considered. The plasma tunnel and arc jet to be used in this study are described, and mathematical equations for the shock tube plasma flow are given. D.E.R.

N63-16918 Emmanuel Coll. Research Language Center, Boston, Mass.
WAVES ALONG HOMOGENEOUS PLASMA LAYERS (WOLLEN LÄNGS HOMOGENER PLASMASCHICHTEN)
W. O. Schumann Apr. 1962 10 p Transl. into ENGLISH from Sitz-Ber. Math.-Naturw. Kl. Bayer. Akad. Wiss. Munchen, 1948 p 255–261
(Contract AF 19(604)-8505)
(AD-276705)

The Maxwell equations are applied to two plasma fields, consisting of an electrically neutral medium with free movable electrons and a given dielectric constant. Damping is disregarded. The fields are joined at a layer at which two endless semi-infinite spaces are located. The continuity conditions, amplitudes, diffusion factors, field conditions, and boundary conditions are calculated for the plasmas, and the radiation vectors are found. D.E.R.

N63-16920 General Electric Co. Heavy Military Electronics Dept., Syracuse, N.Y.
FIVE THEORETICAL PLASMA STUDIES Eleventh Technical Note
Leonard S. Taylor (Space Sciences Lab.) June 1962 57 p 43 refs
(Contract AF 30(602)-1968)
(RADC-TDR-62-260; AD-282894)

Investigated in this report are five different phenomena in the field of plasma studies. These are: (1) the propagation of a plane electromagnetic wave in an exponential ionization density; (2) the development of a kinetic theory of the conductivity of a slightly ionized gas; (3) the reflection of an electromagnetic wave from an inverse parabolic ionization density; (4) the radiofrequency reflectance of plasma sheaths; and (5) the response of a shock ionized layer to high-power radiofrequency fields. C.L.W.

N63-16930 Boeing Scientific Research Labs. Plasma Physics Lab., Seattle, Wash.
THE PARALLEL PLATE PLASMA PROBLEM
Richard B. Hall June 1962 54 p 3 refs
(DI-82-0173; AD-282129)

The parallel-plate plasma problem is considered under the assumption of uniform density and a specular reflection boundary condition at the plates. The impedance of the device is derived for several different models of the plasma medium. The impedance of a hydromagnetic medium exhibits resonances whenever the plate separation is an odd multiple of a half wavelength, as defined by the dispersion relation, while the Boltzmann equation yields similar results which include, however, the presence of losses in a collisionless plasma. The impedance of the plasma capacitor based on the Boltzmann equation is derived by use of Fourier series techniques and leads to a natural determination of an equivalent circuit of the device which is useful for physical understanding. It is also possible to analyze the plasma capacitor by use of a method first derived by Landau in which an integral equation is obtained. An appendix compares, by use of hydromagnetic equations, the cold plasma impedance for a uniform and nonuniform d.c. density distribution and shows qualitative agreement for the two cases. Author

N63-16935 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio
A STUDY OF AN INDUCTION-COUPLED PLASMA OPERATING AT 400 KILOCYCLES
Howard R. Cannon (M.S. Thesis) Aug. 1962 83 p 3 refs
(GA-Phys-62-2; AD-286404)

An RF, electrodeless plasma-generator was developed which operated at peak plasma powers of 50 kw. The plasma was vortex stabilized, and was contained within a water-cooled Vycor tube. Power was measured calorimetrically. Radiation power was measured by alternately using clear water and water made opaque with India ink to cool the Vycor tube. A model temperature profile was deduced from spectrographic measurements transverse to the plasma axis. Maximum plasma temperatures were shown to exist in a thin cylindrical sheath near the plasma surface, with relatively cooler temperatures existing at the center-line gas backflow. Effects of changing gas flow rate, gas composition, RF power, and Vycor-tube diameter on the effectiveness of the energy coupling mechanism are shown. Author

N63-16958 Princeton U. Plasma Physics Lab., N.J.
THE EFFECT OF A HELICAL FIELD ON THE PLASMA BEHAVIOUR IN THE MODEL C STELLARATOR
W. L. Harries, S. Yoshikawa, and R. M. Sinclair Feb. 1963 34 p 19 refs Presented at the Fourth Annual Meeting of the Div. of Plasma Physics, American Phys. Soc., Atlantic City, Nov. 28–Dec. 1, 1962 Submitted for Publication
(Contract AT(30-1)-1238)
(MATT-171)

The superposition of an $l = 3$ helical field on the uniform confining magnetic field of the Model C stellarator introduces a rotational transform of up to 58° at 5 cm radius. Measurements have been made of the effect on the plasma of superimposing this helical field on the confining field. If the confining field of the stellarator is made "symmetric" (if each line of force is closed when no helical field is applied), superimposing the helical field improves plasma equilibrium, and increases the plasma temperature and particle confinement time. When the rotational transform from the ohmic heating current is in the opposite sense to that from the helical winding, such that the net transform near the outer edge of the plasma is zero, a rapid loss of plasma occurs. The effect of a deliberately introduced lack of closure in the vacuum field is minimized by the helical field. Author

N63-16959 Princeton U. Plasma Physics Lab., N.J.
CLADDED LAMINAR OPTICS FOR THE ULTRAVIOLET
J. G. Hirschberg Apr. 1963 7 p 5 refs
(Contract AT(30-1)-1238)
(MATT-187)

Problems in the measurement of the profile of spectral lines in the study of plasmas and plasma devices are discussed. A surface coating or cladding process is described for fused quartz utilizing magnesium fluoride, applied under vacuum evaporation, to produce durable coatings of low refractive index on the quartz which transmitted into the ultraviolet to at least 2000 A. N.E.A.

25 PHYSICS, SOLID-STATE

Includes: semiconductor theory; and masers.

For related information see: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N63-16365 Radio Corp. of America. RCA Labs., Princeton, N.J.
SUSCEPTIBILITY IN SEMICONDUCTORS Final Report, Apr. 1, 1961-Mar. 31, 1963
A. R. Moore and J. O. Kessler David Sarnoff Research Center [1963] 51 p 27 refs
(Contract Nonr-3467(00))

This report is concerned with the magnetic moment M of a plasma consisting of holes and electrons generated by light within a cylindrical semiconductor crystal immersed in a magnetic field. Macroscopic transport equations have been used to derive the dependence of M on field strength, mobility, and surface recombination conditions. In the limits of low and high surface recombination, the theoretical result demonstrates the transition between transverse equilibrium ($M = 0$) and pure magnetic confinement ($M = -nkt/B$). Experiments using germanium and inhomogeneous magnetic field directly measured the diamagnetic force exerted by the plasma on its scattering medium. An induction method utilizing a uniform magnetic field of strength up to 70 kgauss gave collateral results. The dependence of the moment on magnetic field strength, light intensity, temperature, and surface-recombination velocity support the theory. Author

N63-16379 Gt. Brit. Ministry of Aviation. Technical Information and Library Services, Mottingham
LASERS: A BIBLIOGRAPHY COVERING THE PERIOD DECEMBER 1958-MAY 1962
K. J. Spencer May 1962 41 p 409 refs
(*Its* Bibliographical Series No. 4)

An annotated bibliography on lasers is presented, covering the period December 1958 to May 1962. D.M.B.

N63-16399 Columbia Radiation Lab., New York, N.Y.
RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM First Quarterly Progress Report, Dec. 16, 1962 through Mar. 15, 1963
R. Novick Mar. 15, 1963 58 p refs
(Contract DA-36-039-SC-90789)

A detailed study has been made of the metastable lithium atom. The threshold energy (E_0), production cross section (σ), and lifetime (τ) are: $E_0 = 56$ ev, $\sigma = 10^{-19}$ cm^2, and $\tau = 1$ μsec. These values are in reasonably good agreement with the theoretical calculations. The fine structure splitting of the 3P term of the lithium

atom has been determined by level crossing spectroscopy. The observed interval is 2880 mc/sec and is about 12% smaller than the corresponding splitting. The spin, magnetic moment, and quadrupole moment of Cd^{113m} have been determined by optical double resonance. Computational techniques have been developed for the evaluation of fine-structure corrections to the level crossing fields in (sp) configurations. A new electric-resonance molecular-beam apparatus has been constructed and will be used for the study of molecular structure. A new high-temperature microwave absorption spectrometer has been constructed and used for the determination of the rotational structure of LiCl. This spectrometer is unique in that it employs a nitrogen buffer gas to reduce the rate of contamination of the microwave windows and Stark plate insulators. An optical maser has been used for the precise determination of the frequency shifts of the light scattered by an acoustically excited liquid (Debye–Sears effect). Author

N63-16412 Solid State Radiations, Inc., Los Angeles, Calif.
THE APPLICATION OF SEMICONDUCTOR RADIATION DETECTORS TO THE OBSERVATION OF FAST NEUTRONS [Final Report, Apr. 1961–Aug. 1962]
E. L. Zimmerman, G. Baladjanian, A. Brainard, L. Wang, and R. M. Olson Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Dec. 1962 58 p 12 refs
(Contract AF 33(616)-8340)
(ASD-TDR-62-838)

Several methods of utilizing a semiconductor radiation detector for neutron observations have been investigated. Techniques for the application of neutron-sensitive materials to detector surfaces have been developed and the resulting coated detectors have been evaluated as both thermal and threshold detectors. A "good geometry" proton-recoil spectrometer utilizing a semiconductor detector has been built and used to observe fast neutrons. An analytical study of this device resulted in a method which can accurately predict its response as a function of incident neutron energy, hydrogenous radiator thickness, and system geometry. Good qualitative agreement was observed between the predicted and experimental response. Efforts to introduce Li^6 into the sensitive region of a detector in order to make the detector neutron energy sensitive by means of the Li^6 (n,α) T^3 reaction have not been successful to date. However, this effort has contributed substantially to the development of the lithium ion drift detector which in itself is a good 4.5-Mev threshold-neutron detector, as well as a good device for observing minimum ionizing particles. Author

N63-16435 New York U. Washington Square Coll., N.Y.
A STUDY OF THE FAR INFRARED PROPERTIES OF CRYSTALS Scientific Report, Dec. 1, 1961–Feb. 28, 1962
J. H. Rohrbaugh [1962] 9 p 6 refs
(Contract AF 19(604)-2673)
(Rept. 18; AFCRL-62-369)

The procedures used to further the calculations on sodium chloride are described. Experimental results on the index of refraction and the extinction coefficient of KBr at 137μ were obtained but cannot be evaluated until tables of values obtained from a computer can be expanded. Author

N63-16449 Watkins-Johnson Co., Palo Alto, Calif.
RESEARCH AND INVESTIGATION OF MATERIALS FOR LASER APPLICATIONS Interim Engineering Report No. 3, Jan. 1, 1963–Mar. 31, 1963
R. Fitzpatrick and S. E. Sobottka [1963] 18 p 2 refs
(Contract AF 33(657)-8917)
(W-J 63-612R12)

Light emission from pulsed diodes made of Nd doped GaAs and from undoped GaAs diode lasers was investigated. For the Nd doped diode studies, two different doped GaAs samples were used: One of a single crystal material containing an amount of Nd determined by independent analysis to be about 0.01 percent, and one of polycrystalline material containing about 0.7 percent Nd distributed in an unknown manner. Emission measurements of Nd doped diodes revealed lines in the range of 0.1μ to 1.1μ. These lines were not observed with five undoped GaAs diodes and were therefore indicated to be Nd emission lines. This is apparently the first time that emission from rare-earth ions has been reported. This emission indicates that the d.c. excitation of rare-earth centers in semiconductors is possible, as was originally predicted. Therefore the possibility of a low-threshold d.c.-pumped laser using rare-earth doped semiconductors seems assured. Also, diodes from GaAs without Nd have been fabricated according to techniques designed to optimize laser action. Studies of the emission of these diodes, integrated over all wavelengths, have been made as a function of current, up to 10 amps peak, with the diode immersed in liquid N_2. Results indicate that laser action occurs at peak currents above a few amps (current density about 10^3 amp/cm^2). I.v.L.

N63-16451 Maryland U., College Park
GIANT RESONANCE DIPOLE TRANSITIONS IN NUCLEI
Richard A. Ferrell Aug. 1962 10 p Presented at the Gatlinburg Conf. on Electromagnetic Transitions and Lifetimes in Nuclei, Oct. 1961
(Partially Supported by ONR)
(Tech. Tech. 268)

This report deals with: (1) the elastic scattering of gamma rays by deformed and nondeformed nuclei, (2) dipole excitations based on excited states of the nuclei, and (3) the damping of the giant dipole resonance. I.v.L.

N63-16489 Michigan U. Inst. of Science and Tech., Ann Arbor
PHOTOVOLTAIC EFFECTS IN RUTILE Memorandum of Project MICHIGAN
R. Keezer, J. Muder, and D. E. Brown May 1963 9 p 9 refs
(Contracts DA-36-039-SC-78801 and AF 33(616)-8410; Proj. Michigan)
(Memo. 2900-398-R)

The ultraviolet photovoltaic response of barrier-layer cells formed from single-crystal rutile has been investigated. Typical samples have response maxima at 3200 Å, a detectivity D of 10^9 cm-cps$^{1/2}$/w, and time constants of 100 μsec. Variations in time constant over several orders of magnitude have been observed; they depend largely on preparation technique. The effect of surface treatment on cell characteristics is discussed. Author

N63-16499 Oak Ridge National Lab., Tenn.
ELECTRONUCLEAR DIVISION Annual Progress Report, For Period Ending Dec. 31, 1962
M. L. Halbert et al May 24, 1963 93 p refs
(Contract W-7405-eng-26)
(ORNL-3432) OTS: $2.25

Progress in electronuclear physics research at the Oak Ridge National Laboratories is reported. The fields of study are: heavy particle physics, research with 22-Mev protons, theoretical nuclear studies including scattering, cyclotron experiments and operation, accelerator development, the Oak Ridge isochronous cyclotron, and superconducting-magnet development. D.E.R.

N63-16500 Oak Ridge National Lab., Tenn.
DESCRIPTION OF PRINTED OUTPUT FROM INTRANUCLEAR CASCADE CALCULATION
H. W. Bertini May 28, 1963 95 p 2 refs
(Contract W-7405-eng-26)
(ORNL-3433) OTS: $2.25

This report gives a detailed description of the printed output sheets from the intranuclear cascade calculation described in ORNL-3383. Author

N63-16501 California U., Berkeley. Lawrence Radiation Lab.
POLARIZATION OF RECOIL PROTONS IN PION-PROTON ELASTIC SCATTERING AT 523, 572, AND 689 MeV
Richard D. Eandi Mar. 18, 1963 83 p 38 refs
(Contract W-7405-eng-48)
(UCRL-10629) OTS: $2.00

Angular distributions of recoil-proton polarization for elastic scattering of positive and negative π mesons on protons were measured at 523, 572, and 689 Mev incident-pion kinetic energy. Polarization measurements were made by observing the azimuthal asymmetry of sample angular distributions of recoil protons which scatter in large carbon-plate spark chambers. The spark chambers proved to be very suitable polarization analyzer-detectors. The spark chambers were triggered by an array of scintillation and Cerenkov counters which identified the particles entering the chambers as recoil protons from elastic pion–proton scattering. Two plausible nonunique sets of phase shifts were obtained by employing: (a) restrictive assumptions related to the higher resonances, (b) available pion–proton total and differential cross sections measured at nearby energies, and (c) the measurements of this experiment. One set is characterized by J = 3/2, T = 1/2, D-wave resonance; the other set is characterized by a J = 3/2, T = 1/2, P-wave resonance at 600-Mev incident-pion energy. Author

N63-16520 California U., Los Angeles
LATTICE VIBRATION SPECTRA FOR $LaCl_3$ AND $LaBr_3$ Technical Report No. 4
Isaac Richman Jan. 1963 95 p 18 refs
(Grant DA-ARO(D)-31-124-G75)
(AROD-2099:13)

The absorption spectra of Pr^{3+} in $LaCl_3$ and $LaBr_3$ have been studied. These spectra exhibit satellite lines lying close to lines which are known to result from electronic transitions. It has been assumed until now that the satellite lines in spectra of lanthanides in $LaCl_3$ result from a simultaneous change in lanthanide electronic state and some crystalline vibrational state. To test this hypothesis, spectra of single crystals of $LaCl_3$ and $LaBr_3$ doped with Pr^{3+} were obtained in the photographable region. $LaBr_3$ is isomorphous to $LaCl_3$ and has very similar chemical properties. There, if the hypothesis is correct, the major effect of the change of anion from Cl^- to Br^- would be a shift of vibrational levels to the red because of the increased mass. Indeed the satellite spectra of the two crystals are quite similar and the shift to the red was observed. The amount of the shift was that expected from the hypothesis. Spectra of pure $PrCl_3$ and $PrBr_3$ were also obtained. Their satellite spectra were similar to those of their dilute counterparts except for the appearance of several new lines. Some possible explanations for these new lines are given but their origin remains in doubt. A tentative assignment of symmetry type to the observed vibrational levels has been given. Author

N63-16560 European Atomic Energy Community, Brussel (Belgium)
POSSIBILITY OF NON DESTRUCTIVE ANALYSIS OF FUEL ELEMENTS CONTAINING U^{235} (POSSIBILITÉ D'ANALYSE NON DESTRUCTIVE DE MATÉRIAUX COMBUSTIBLES À BASE D' ^{235}U)
P. Guillot and P. Varekamp Joint Nuclear Res. Center, Ispra Establishment (Italy), Reactor Physics Dept., Mar. 1963 28 p 1 ref In FRENCH; ENGLISH abstract
(EUR-248.f) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86: 50 BF

An existing method for the measurement of the uranium enrichment has been improved to allow the nondestructive analysis of natural uranium carbides or oxides. It is possible to measure the U^{235} amount, of the order of 10 grams, in fuel elements within an error 0.5% so that the indirect determination of the carbon or oxygen is made within an error of 10% or 3%, respectively. Author

N63-16852 California U., Los Angeles
COVALENCY EFFECTS IN SPECTRA OF Pr^{3+} AND Nd^{3+} IN $LaCl_3$ AND $LaBr_3$ Technical Report No. 3
Isaac Richman Jan. 1963 53 p 20 refs
(Grant DA-ARO(D)-31-124-G75)
(AROD-2099-12)

The absorption spectra of Pr^{3+} in $LaCl_3$ and $LaBr_3$ have been studied. It has been assumed until now that the satellite lines in spectra of lanthanides in $LaCl_3$ result from a simultaneous change in lanthanide electronic state and some crystalline vibrational state. To test this hypothesis, spectra of single crystals of $LaCl_3$ and $LaBr_3$ doped with Pr^{3+} were obtained in the photographable region. $LaBr_3$ is isomorphous to $LaCl_3$ and has very similar chemical properties. There, if the hypothesis is correct, the major effect of the change of anion from Cl^- to Br^- would be a shift of vibrational levels to the red because of the increased mass. The satellite spectra of the two crystals are quite similar, and the shift to the red was observed. The amount of the shift was that expected from the hypothesis. The number and symmetry types of unit cell normal modes was calculated, as well as a set of unit cell symmetry coordinates. Author

N63-16884 California U., La Jolla. School of Science and Engineering
SPALLATION PRODUCTS DISTRIBUTED IN A THICK IRON TARGET BOMBARDED BY 3-Bev PROTONS
Masatake Honda Repr. from J. Geophys. Research, v. 67, no. 12, Nov. 1962 p 4847–4858 11 refs
(NASA Grants NsG-97-60 and NsG-98-60)
(NASA-CR-50194)

The distribution of several spallation products, covering a wide range of atomic number, has been measured in a thick iron target (30 × 30 × 90 cm) bombarded by 3-Bev protons at the Brookhaven cosmotron. Measurements were made of the radioactivity of γ-, β-, and X-ray emitters, either directly or after chemical separation, in iron and nickel foils placed at different depths. Products such as Co isotopes in Ni and Fe^{55}, Mn^{54}, and Cr^{51} in Fe, which are close to the target mass, were produced in important amounts at large angles to the primary beam. Production of nuclides of lower A showed gradually better collimation, Na^{22} and Be^7 showing the smallest spread. These data provide useful information on the production rates of cosmogenic nuclides in meteorites and on their variation with depth and size. The results of this experiment may be compared with the available meteorite data and with other calculations. Author

N63-16960 Princeton U. Plasma Physics Lab., N.J.
FREQUENCY-DEPENDENT RELAXATION TIME OF ELECTRON-PHONON SYSTEMS
Amiram Ron (Technion-Israel Inst. of Tech.) Apr. 1963 19 p 16 refs
(Contract AT(30-1)-1238)
(MATT-188)

A derivation of the frequency-dependent relaxation time in a simple model of metal, composed of electrons and phonons, is presented. The problem is investigated by a quantum-kinetic description of the response of the electron–phonon system to an oscillating electric field. The treatment, which stems from a proper time-dependent transport equation, does not have the time-scale restriction of the usual transition probability approach, and does give a proper description of the time-dependent collective effects. Author

N63-16981 Pennsylvania U. Lab. for Research on the Structure of Matter, Philadelphia
THEORY OF HIGH-TEMPERATURE MAGNETOSTRICTION Technical Report No. 6
Herbert B. Callen and Earl R. Callen (Naval Ord. Lab.) [1963] 23 p 11 refs
(Contract Nonr-551(36))

A mechanism is proposed which accounts qualitatively for the magnitude and location of the high-temperature maximum of λ_{100} in iron, for the shift and broadening of the maximum with the addition of silicon, for the absence of the effect in nickel, and provides criteria for the presence of the effect in other materials. Furthermore, the theory properly predicts the monotonic behavior of λ_{111} and the fact that λ_{111} and λ_{100} are of opposite sign.
C.L.W.

26 PROPELLANTS AND COMBUSTION

Includes: fuels; igniters; and oxidizers.

For related information see: 07 Chemistry; and 27 Propulsion.

N63-16374 Monsanto Research Corp. Boston Labs., Everett, Mass.
RESEARCH ON SYNTHESIS OF NEW OXIDIZERS FOR SOLID PROPELLANTS Quarterly Technical Summary Report No. 3, Jan. 1, 1963-Mar. 31, 1963
James W. Dale, Stephen P. Terpko, and George A. Tsigdinos Apr. 22, 1963 32 p 16 refs
(Contract AF 04(611)-8520; ARPA Order 352-62)
(MRB-2022Q3)

Investigation of interactions and compatibility of various binary and ternary combinations of active oxidizers (NO_2F, NOF, N_2F_4, ClO_3F, etc.) in liquid OF_2 has continued. The binary systems NF_3/OF_2, ClO_3F/OF_2, and N_2F_4/OF_2, and the ternary system $ClF_3/ClO_3F/OF_2$, showed complete miscibility, the latter under pressure at −78° C. Pure NOF has been found not to react with OF_2; the explosive reaction reported in the literature ($NOF + OF_2 \rightarrow NF_3 + O_2$) was probably due to a large NO content in the supposedly pure NOF. Conductimetric investigation involving compounds formulated as containing ClF_2^+ and ClF_4^- ions is continuing using ClF_3 as ionizing solvent. The "neutralization," $ClF_2^+AsF_6^- + NO^+ClF_4^- \rightarrow NOAsF_6 + 2ClF_3$, can be followed by conductimetric titration to a sharp end-point at 1:1 stoichiometry. A new and facile route to the derivatives $MClF_4$ (M = K, Rb, Cs) has been found to give these compounds in high yield and good purity. The new compounds $(ClF_2)_2SnF_6$ and $(ClF_2)_2TiF_6$ have been synthesized and tentatively identified. Author

N63-16398 Aeronutronic, Newport Beach, Calif
INVESTIGATION OF THERMODYNAMIC PROPERTIES OF ROCKET COMBUSTION PRODUCTS Second Quarterly Technical Report, 1 Jan. -31 Mar., 1963
D. L. Hildenbrand, L. P. Theard, and F. Ju Apr. 30, 1963 25 p 14 refs
(Contract AF 04(611)-8523; ARPA Order 348-62)
(U-2116)

An increase in the volatility of beryllia in the presence of water vapor was observed with the mass spectrometer at 2170° K and 0.1-mm water pressure. However, the mass spectrum was complicated by hydrocarbons produced by reaction of $H_2O(g)$ with carbon present as an impurity in the beryllia cell liner. A limiting value for the heat of formation of $Be(OH)_2(g)$ was derived. Studies of the variation of Be_2O^+ ion intensity with temperature and ionizing electron energy present further evidence for the presence of $Be_2O(g)$ in the vapor in equilibrium with BeO(c). Mass spectrometric studies of the vaporization of beryllium chloride in the range 480° to 540° K indicate that the saturated vapor contains at least 5% $Be_2Cl_4(g)$, in addition to $BeCl_2(g)$. A definitive measure of vapor composition can be obtained when the cracking pattern of $BeCl_2(g)$ is known; such experiments are planned. Tentative second-law heats of sublimation of $BeCl_2(g)$ and $Be_2Cl_4(g)$ at 500° K have been obtained as 34.2 and 35.8 kcal/mole, respectively. Initial experiments with tungsten Knudsen cells indicated considerable reaction between $BeCl_2$ and tungsten; later measurements were made with platinum cells. The thermal properties of beryllium chloride are discussed. Further measurements of the AlF pressure over BeF_2-Al mixtures have been made. From a third-law analysis, the heat of formation of $BeF_2(g)$ at 298° K has been derived as -187 ± 3 kcal/mole. The measurements of the BeF_2-Al system indicate also that the dissociation energy of BeF(g) is less than 6.7 ev. Author

N63-16405 Reaction Motors Div., Thiokol Chemical Corp., Denville, N.J.
STUDY OF A TRACER METHOD FOR SOLID PROPELLANTS [Final Report, June 19, 1961-June 18, 1962]
David Fleischer Holloman AFB, N. Mex., Office of Aerospace Res., Feb. 1963 52 p 4 refs
(Contract AF 29(600)-3020)
(RMD-5502-F; ORA-63-3)

A photometric method for determining local burning rates in solid propellant motors is described. Metallic salt-polymer mixtures (tracers) are inserted in known locations in the motor. Resonant radiation from the vaporized metal provides light pulses in the motor exhaust. Spectrographic time resolution of these pulses and the known distances between deposits in the grain yield the burning rates. Preliminary strand experiments are used to estimate burning rates of tracer and propellant under engine conditions. These values are introduced in an expression relating accuracy of photometric burning rate to tracer thickness, separation between tracer deposits, and tracer and propellant burning rates. Tracer thickness and separation in the test engine for a desired accuracy are thus defined. Engine burning rates reproducible to ±7 percent for a one centimeter separation were easily obtained. Author

N63-16443 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
PERFORMANCE CALCULATIONS FOR MONOPROPELLANT HYDRAZINE AND MONOPROPELLANT HYDRAZINE-HYDRAZINE-NITRATE MIXTURES
Donald H. Lee Dec. 3, 1962 92 p 9 refs
(NASA Contract NAS7-100)
(JPL-TR-32-348) OTS: $8.60 ph, $2.96 mf

Results of thermochemical performance calculations are presented for the monopropellant hydrazine system and several monopropleiant hydrazine–hydrazine nitrate mixtures. In view of the ability to obtain dissociation of the ammonia present in the gaseous exhaust products by utilizing catalysts in the decomposition of these propellants, data are presented for the cases of 0%, 20%, 40%, 60%, 80%, and equilibrium ammonia dissociation. Performance values for expansion ratios up to 200:1 are presented at chamber pressures of 50 psia, 150 psia, 300 psia, and 1000 psia. All results were calculated by the free-energy minimization method. Author

N63-16673 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DISCREPANCIES WITH Δp SENSORS FOR MONITORING LIQUID PROPELLANT SLOSHING DURING ROCKET FLIGHT
Werner R. Eulitz Aug. 10, 1962 29 p 3 refs
(MTP-P&VE-P-62-6; NASA TM X-50026) OTS: $2.60 ph, $1.07 mf

This study was made to investigate the suitability of Δp sensors for monitoring liquid-rocket-propellant sloshing during flight. A generalized amplitude equation has been derived that is applicable to any liquid level. It was realized that a conversion factor was essential for translation of subsurface amplitude measurements into surface amplitude characteristics. Thus, the conversion factor is the ratio of the amplitudes of two unequal levels of the same liquid. The reciprocal of the conversion factor represents the sensitivity of the Δp system at different liquid levels. Because the theory developed in this study agrees satsifactorily with test results, it must be concluded that Δp sensors are not suitable for monitoring of liquid rocket propellant sloshing during flight. Author

N63-16870 Rocket Power, Inc., Pasadena, Calif.
STUDY OF ROCKET ENGINE EXHAUST PRODUCTS Seventh Quarterly Report, 1 December 1962 through 31 March 1963
M. A. Greenbaum et al [1963] 16 p 9 refs
(Contract AF 04(611)-7414)
(QR-7414-7)

Definitive values for the heat and entropy of sublimation of $BeCl_2$ have been obtained in the temperature range of 440° to 600° K. Employing estimated thermal functions Δ^{298}_{sub} was found to be 33.1 ±0.5 kcal/mole and ΔS^{298}_{sub} was 43.2 ±1.5 cal/deg/mole. The vapor in this temperature range has been confirmed as monomeric $BeCl_2(g)$. This report also presents preliminary second- and third-law measurements for the ΔH_f and ΔS_f of BeCl(g). Author

N63-16956 Massachusetts Inst. of Tech., Cambridge
FURTHER STUDY ON FLAME STABILIZATION IN A BOUNDARY LAYER: A MECHANISM OF FLAME OSCILLATIONS
W. S. Wu (IBM Corp.) and T. Y. Toong [1962] 37 p 12 refs
(Grants NSF-G-3274 and NSF-G-7039)

A mechanism of flame oscillation is proposed in an attempt to explain the flame oscillation phenomena in a boundary layer and also to bring together with a unified theory the two distinct types of flame stabilization in a boundary layer. These types are: (1) the steady flame and (2) the oscillating flame. The proposed hypothesis is further employed to examine and alleviate some of the doubts concerning the use of the equilibrium theory to correlate oscillating-flame data by a group of parameters. The proposed hypothesis postulates that the oscillation phenomenon of the flame in a boundary layer is caused by the instability of the boundary-layer flow. The adverse pressure gradient immediately upstream of the flame nose in the boundary layer and the heat transfer to the unburned mixture from the solid boundary make the boundary-layer flow highly unstable. This instability, combined with the basic principles of flame stabilization and propagation, sets off the oscillation. N.E.A.

27 PROPULSION

Includes: airbreathing, electric, liquid, nuclear, and solid propulsion.

For related information see: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N63-16362 Martin Co., Baltimore, Md.
FEASIBILITY STUDY OF WATER-COOLED THERMIONIC NUCLEAR POWER PLANT
Washington, AEC Div. of Tech. Information, Nov. 1962 204 p
(Contract AT(30-1)-2990)
(MND-2903 (Vol. 1)) OTS: $3.00

This volume contains a justification, description, and evaluation of a water-cooled thermionic plant. A comparison among various concepts is made, and a justification for the selected plant is given. A conceptual design is presented along with an evaluation of the characteristics and performance of this plant. The costs of building and operating the plant are based on the assumption that it is one of ten produced. A discussion of the results obtained and conclusions that may be drawn from these results and the studies conducted during the program is presented in a separate section. A series of appendices describe in detail fuel-element geometry, thermionic-diode analysis, system-control analysis, reliability and maintainability of this plant, and transportability of this plant. Author

N63-16440 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE STRUCTURAL DYNAMIC BEHAVIOR OF A TANK-MOUNTED LIQUID-PROPELLANT ROCKET ENGINE
T. E. Lang Dec. 8, 1961 31 p 10 refs
(NASA Contract NASw-6)
(JPL-TR-32-194) OTS: $3.60 mf, $1.13 ph

Results are presented of a series of tests performed to evaluate the structural dynamic properties of a 6,000-lb-thrust liquid-propellant propulsion system developed by the Jet Propulsion Laboratory. The component parts of the structure tested include the engine chamber and valve body, gimbal, engine support cone, propellant tank, and engine directional-control actuators. Information derived from the tests include natural frequencies, damping coefficients, and mode shapes for vibration of the structure in bending, torsional, and longitudinal modes; axial response curves for excitation of the structure with random time-varying forces; and component flexibilities from associated static tests. Author

N63-16587 Calorobic Materials, Inc., Pearl River, N.Y.
DEVELOPMENT AND UTILIZATION OF OPTIMUM TECHNIQUES FOR THE FABRICATION OF TITANIUM BORONITRIDE ROCKET NOZZLES Second Quarterly Report, Oct. 1-Dec. 31, 1962
R. Strickman and J. Donnellon Jan. 1963 14 p
(Contract DA-30-069-ORD-3747)
(WAL-TR-371.9/5)

The need for rigorous control on the raw materials used in subsequent processing steps was found to be required. In the fabrication of various specimens to final dimensions of Compositions A and B, identical tooling and cutting speeds and feeds were used. The scalping operation of the product bar was optimized by the newly developed diamond wheel-turning

technique. X-ray nondestructive inspection procedures and norms, for both material compositions, were established. Tooling for the HTB-3 rocket-nozzle-insert compacts was completed and tested. Author

N63-16676 Curtis-Wright Corp. Wright Aeronautical Div., Wood-Ridge, N.J.
INVESTIGATION OF FEASIBILITY OF A POSITIVE DISPLACEMENT INJECTOR FOR ATTITUDE CONTROL PROPULSION Final Report, Sept. 1962-Jan. 1963
D. L. Ryan and G. Kelley Jan. 1963 147 p 8 refs
(NASA Contract NAS7-185)
(CTR 00-270; NASA-CR-50043) OTS: $11.00 ph, $4.61 mf

A positive displacement injector for providing attitude control of space vehicles is reviewed. This injector is basically a variant of a conventional bipropellant reaction control system which uses solenoid values to control propellant flow. However, the injector differs in that mechanically linked fuel and oxidizer injectors coupled with an actuator replace the propellant solenoid valves. Results indicate that: (1) Mechanical design of a reliable injector with adequate frequency capability and extended life appears entirely feasible. (2) The positive displacement injector shows considerable promise of being capable of operating in a manner which will result in materially improved propellant performance and, thus, reduced system weight. Therefore, it can be concluded that this injector would be applicable to systems normally requiring a pulsing mode of operation for attitude control. I.v.L.

28 SPACE RADIATION

Includes: cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts.

For related information see: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N63-16346 Vitro Labs., West Orange, N.J.
ALBEDO AND PLANET RADIATION INTERCEPTED BY AN EARTH SATELLITE
C. E. Fitz, S. J. Lukasik, E. A. Mayer, and D. R. Simon Arnold Engineering Development Center, May 1963 103 p 27 refs
(Contract AF 40(600)-951)
(AEDC-TDR-63-92)

The characteristics of the secondary radiation environment of an earth satellite were analyzed and compared with the characteristics of solar radiation. Of the total incident radiation, 27% is reflected from earth and clouds and 9% is scattered, bringing the total albedo contribution to 36%. The remaining 64% of the incident energy is absorbed by the earth and reradiated as planet radiation. Of this energy, 17% is radiated as thermal radiation from the earth, and 47% as thermal radiation from the stratosphere. The spectral distribution of the reflected solar radiation corresponds to that of a black body at 6000° K while the energy, which is reradiated, corresponds to a black body at approximately 250° K. In the wavelength region below 4 microns, albedo radiation has the higher spectral intensity, peaking at about 10^{-1} watts/cm^2 μ; above 4μ, peak spectral intensity is approximately 10^{-3} watts/cm$^2\mu$. An analysis was made of the angular distribution of the solar, albedo, and planet radiation received by an earth satellite. Tolerances on simulating the radiation characteristics were analyzed based on possible thermal and material effects upon a space vehicle. Author

N63-16434 California U., Los Angeles. Inst. of Geophysics and Interplanetary Physics
THE GROWTH OF OUR KNOWLEDGE OF THE EARTH'S OUTER RADIATION BELT
T. A. Farley Repr. from Rev. Geophys., v. 1, no. 1, Feb. 1963 p 3-34 70 refs
(NASA Grant NsG-249-62)

The development of our knowledge of the outer Van Allen radiation zone is surveyed. In general, the approach within each topic is historical. The early discoveries of the gross features of the radiation belt, the difficulties encountered in determining the electron energy spectrum, and the misinterpretation of geomagnetic storm intensity changes due to inadequate knowledge of the electron spectrum are discussed. Also considered are the equatorial pitch-angle distributions of electrons, the presence of protons in the outer zone, and the question of a "slot" between the inner and outer zones. The calculations of the neutron albedo contribution of electrons to the outer zone are reviewed; the contribution appears to be inadequate, because the resulting energy spectrum is incorrect, the intensity inadequate, and the required lifetime too long. Observations of electron precipitation into the atmosphere are briefly reviewed, and several possibilities for the connection of such observations to the intensity and lifetimes of trapped electrons are listed. Author

N63-16459 Rochester U., N.Y.
ESTIMATE OF NEUTRON ALBEDO ON THE MOON'S SURFACE DUE TO COSMIC RAY BOMBARDMENT
M. V. Krishna Appa Rao May 17, 1963 6 p 6 refs Submitted for Publication
(Contract AT(30-1)-875)
(NYO-10265)

An estimate based on calculations made for chrondrite and basalt rocks, which probably constitute the moon's surface, is presented for the neutron albedo on the moon's surface due to cosmic radiation. The total neutron albedo for the top 1 c.c. of the moon's surface, assuming basaltic composition, was calculated to be 2.12×10^{-2}/sec. To obtain the total number of neutron albedo from a column of 1 c.c., multiplication of the above number by the free path of neutron absorption in the rock, which was calculated to be approximately 8 cm, was performed. The neutron albedo due to the interaction of protons and helium nuclei was then calculated and totaled, thus giving the total neutron albedo of 0.26/sec cm^2 for basaltic rock. The corresponding value for chrondritic rock was calculated to be 0.35/sec cm^2. N.E.A.

N63-16470 Douglas Aircraft Co., Inc. Missile and Space Systems Div., Santa Monica, Calif.
SUMMARY OF PRESENT KNOWLEDGE ON SPACE RADIATION
A. D. Goedeke Feb. 1963 55 p 53 refs Presented at the 1963 Natl. Winter Conv. on Military Electronics, Los Angeles, Feb. 1, 1963
(Eng. Paper 1567)

This paper discusses the present knowledge of the nature and properties of interplanetary plasma, galactic, solar, and trapped radiations. Particular emphasis is placed upon solar cosmic radiation, solar flares, solar-terrestrial relationships, and time variations. Results of analyses of various events are described in light of biological-dose restrictions. Present research programs on prediction of solar cosmic rays and their time variations are also discussed. Author

N63-16496 National Bureau of Standards. Central Radio Propagation Lab., Boulder, Colo.
COMPILATIONS OF SOLAR-GEOPHYSICAL DATA
Feb. 1962 39 p

This report lists the data and time of the observation, the approximate heliocentric coordinates, and the magnetic classification of the sunspot groups, as observed at the Mt. Wilson Observatory. The maximum magnetic information is defined and classified as follows: (1) all magnetic measures in the group of the same polarity which is that corresponding to the preceding spots in that hemisphere for that cycle; (2) all magnetic measures in the group of the same polarity which is that corresponding to the following spots in that hemisphere for that cycle; (3) a bipolar group in which the magnetic measures indicate that the preceding spots are dominant; (4) a bipolar group in which the magnetic measures indicate a balance between the preceding and following spots; (5) a bipolar group in which the magnetic measures indicate that the following spots are dominant; (6) a group which has general beta characteristics but in which one or more spots are out of place as far as the polarities are concerned; and (7) a group in which the polarities are completely mixed.
N.E.A.

N63-16641 National Aeronautics and Space Administration, Washington, D.C.
COSMIC DUST SHOWERS BY DIRECT MEASUREMENTS
W. M. Alexander, O. E. Berg (NASA, Goddard Space Flight Center), and M. Dubin *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 109–117 13 refs (See N63-16627 14-01) GPO: $2.75

From the available data on direct measurements of cosmic dust made with satellites and rockets, evidence of large fluctuations in the flux of cosmic dust is presented. The significance of these measurements is reviewed. Although direct measurements from satellites have been made over a period of about four months and during the time of other known meteor streams, so far only two interplanetary dust streams have been detected by direct measurements.
N.E.A.

N63-16670 Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.
PRIMARY COSMIC RAY AND SOLAR PROTONS. II
Peter Meyer and Rochus Vogt Repr. from Phys. Rev., v. 129, no. 5, Mar. 1, 1963 p 2275–2279 12 refs
(NASA Grant NsG-144-61)
(NASA-CR-50045)

During July and August 1961, the energy spectrum of primary cosmic-ray protons was investigated in the energy range from 80 to 350 Mev. The observations were made in five high-altitude balloon flights at geomagnetic latitudes $\lambda \geq 73°$ N. Solar-flare and quiet-day spectra were obtained. A comparison of the 1960 and 1961 results leads to the following conclusions: (1) A significant flux of low-energy protons is continually present in the primary radiation in the years of high solar activity. (2) This flux decreases with the declining level of solar activity as the galactic cosmic-ray flux increases. It is, therefore, suggested that it is of solar origin. (3) The time dependence of the observed proton flux suggests the following alternatives: (a) the particles are produced or released more or less continuously by the sun and do not originate only in the large flare events, or (b) the particles are produced in individual large solar flares and subsequently stored over long periods of time. This second alternative would require a new and as yet unknown storage mechanism with a characteristic time of about 30 or more days.
Author

N63-16678 Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.
RADIOACTIVITY INDUCED IN DISCOVERER 17 BY SOLAR FLARE PROTONS
James E. Keith and Anthony L. Turkevich Repr. from J. Geophys. Res., v. 67, no. 12, Nov. 1962 p 4525–4532 15 refs
(NASA Grant NsG-128-61)
(NASA-CR-50033)

A sheet of lead 7 mm thick, part of the recovered United States satellite Discoverer 17, has been examined for evidence of bombardment by solar protons while the satellite was in a polar orbit (November 12–14, 1960) during a class 3^+ solar flare. Bismuth 205 from the reactions $Pb^{206}(p, 2n)Bi^{205}$, $Pb207(p, 3n)Bi^{205}$, and $Pb^{208}(p, 4n)Bi^{206}$ has been isolated by radiochemical techniques from 100-gram quantities of the lead and counted by X-ray gamma coincidence scintillation spectroscopy. The radioactivity at the time of recovery was about 1000 dpm of Bi^{205} per kilogram of lead. Known cross sections for the nuclear reactions involved lead to an integrated omnidirectional flux above 57 Mev of 5.7×10^8 protons/cm^2. The energy spectrum of the protons is deduced from the variation in depth of the Bi^{205} radioactivity. The exponent in the inverse-power-law differential energy spectrum is between 5 and 6.
Author

N63-16707 National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
OBSERVATIONAL ASTROPHYSICS FROM ROCKETS; STELLAR SPECTRA
Theodore P. Stecher and James E. Milligan [1962] 15 p 14 refs Presented at the COSPAR Meeting, May 1962
(NASA TM X-50021; NASA-X-613-62-30) OTS: $1.60 ph, $0.80 mf

The first attempts to obtain ultraviolet stellar spectra from above the earth's atmosphere using sounding rockets are described. An Aerobee rocket containing two pairs of longwave (minimum λ 1700) and shortwave (minimum λ 1300) objective grating stellar spectrometers was launched Nov. 22, 1961. The spin of the rocket provided the spectral scan as well as the scan for objects of interest. Significant results reported include a very high surface brightness on the northern horizon interpreted as an ultraviolet aurora associated with a solar event, and an apparent emission form the earth's atmosphere in the 1300Å to 1800Å region. Good ultraviolet stellar spectra were obtained for seven stars, and useable spectra were obtained for several others. Comparisons of the observed absorption and luminosity with the theoretical model atmospheres for these stars showed good agreement for the lowest temperature star observed but, for the rest of the stars, a deficiency in flux started at λ2400; this discrepancy increased to a factor of more than ten at λ1800. This large discrepancy in flux will also require a necessary revision of the interstellar radiation field.
M.P.G.

N63-16708 National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY SOLAR FLARE OBSERVATIONS WITH A SOFT X-RAY SPECTROMETER ON THE ORBITING SOLAR OBSERVATORY
W. E. Behring, W. M. Neupert, and J. C. Lindsay [1962] 15 p 3 refs Presented at the COSPAR Meeting, May 1962
(NASA TM X-50023; NASA-X-614-62-29) OTS: $1.60 ph, $0.80 mf

Preliminary results of the first long-term measurement of the soft X-ray solar spectrum obtained by the spectrometer on the first Orbiting Solar Observatory (OSO) satellite are presented. The spectrometer was designed specifically to measure solar spectrum wavelengths from 10 to 400 Å. A similar instrument was flown on an Aerobee rocket, and an attempt to identify the resonance lines of highly ionized atoms of the

heavier elements, and also ions known to exist in the solar atmosphere. On the basis of the rocket spectrometer scans, tentative wavelength assignments were made for these species. The first solar flare after the launch of the OSO was a 2^+ flare occurring on March 13, 1962; the OSO spectrometer data have been partially reduced for the six orbits surrounding the beginning of the visual flare. Three spectral lines were chosen for analysis: He II Lyman Alpha at 303.8A, 284A tentatively identified as an Fe XV line, and 171 A of unknown origin. Using average values for these three lines before the onset of the flare and during the flare, the percentage enhancements for the lines were as follows: 304A, 10%; 283A, 34%; and 171A, 35%. Further analysis and interpretation of the data obtained since OSO launch should elucidate energy transport in the solar corona and the relaxation time of the corona, as well as form a basis for a more complete model of the solar chromosphere. M.P.G.

N63-16728 Southwest Center for Advanced Studies, Dallas Tex.

TERMINATION OF SOLAR WIND AND SOLAR MAGNETIC FIELD

W. I. Axford, A. J. Dessler, and B. Gottlieb Oct. 26, 1962 43 p 25 refs Submitted for Publication
(NASA Grant NsG-269-62)
(NASA-CR-50153) OTS: $4.60 ph, $1.49 mf

The solar magnetic field is twisted into an Archimedes spiral by the outward flowing solar wind; this spiral field must also, on the average, corotate with the sun in order for the solar wind to move radially outward without cutting magnetic lines of force. The interaction between the solar wind and the galactic magnetic field and interstellar medium results in the formation of a shock wave at a heliocentric distance of the order of 50 AU. Beyond the shock, the energy of the solar wind is transferred to the interstellar neutral atomic hydrogen by charge exchange. Instabilities at the boundary between the solar plasma and the galactic medium cause blobs of solar plasma to form which are disconnected from the solar magnetic field by Sweet's mechanism; oppositely-directed lines of force are joined to make large semipermanent magnetic "tongues." The solar-wind energy that is transferred to neutral hydrogen is transported out into the galaxy by radiation or thermal conduction. It is found that the solar magnetic field does not permit solar-wind velocities less than about 100 km/sec. Author

N63-16780 Vitro Labs., West Orange, N.J.

SOLAR RADIATION SIMULATION STUDIES, PART I

R. H. Bull, M. A. Dachs, and M. R. Shenker (Farrand Optical Co.) W. A. Jaatinen, and D. L. Rothacker Arnold Eng. Development Cen., May 1963 75 p 215 refs
(Contract AF 40(600)-951)
(AEDC-TDR-63-90; VL-2244-3-0)

This report describes a survey of radiation sources and preliminary optical studies. In addition to closely approximating solar radiation in spectral characteristics, intensity, and collimation, the radiation must be uniform across the test area and throughout the test volume. The system should also be capable of extended operation. A survey and evaluation of existing and proposed radiation sources indicate that short arc lamps appear to be the most feasible source for further investigation. A hypothetical reference optical-system module was designed, and curves were prepared, showing spectral distribution of transmittance of typical window materials, reflectance of mirrors, and transmittance of the module before filtering. Preliminary studies were made of energy conversion, efficiency, cooling, radiation stability of windows and lenses, and other optical-system characteristics. Author

N63-16793 Vitro Labs., West Orange, N.J.

SOLAR RADIATION SIMULATION STUDIES, PART 2 Technical Documentary Report [Nov. 1961–Jan. 1962]

W. A. Jaatinen, D. L. Rothacker, C. D. Fitz, R. H. Bull, M. A. Dachs, and M. Shenker (Farrand Optical Co., Inc.) Arnold Eng. Development Center, May 1963 121 p refs
(Contract AF 40(600)-951)
(VL-2244-6-0; AEDC-TDR-63-91)

Studies and tests performed to establish the feasibility of solar simulation systems for an environmental chamber are reported. Performance objectives for the chamber and other solar simulator systems have been delineated and compared. The earlier survey of radiation sources had shown that short-arc lamps have sufficient feasibility for this application to warrant further critical testing. Tests were initiated on several sources of this type including the 10-kw xenon lamp, the 2.5-kw xenon-mercury lamp, and the fluid-transpiration arc source. More energy in line spectra was detected than had previously been reported. The 10-kw lamp had excessive radiant energy relative to the solar spectrum in the near infrared range. This energy must be reduced by filters. A deficiency of energy also relative to the solar requirement was noted in the range below 0.6 microns. A reference module optical system concept based upon three and one-half on-axis reflectors is examined. Ray-tracing techniques are applied to determine the collimation and uniformity obtainable with an ideal short-arc source, and optical efficiencies of the several components are examined. After determination of the module efficiency, the number of molecules required to illuminate the chosen test area and the amount of power required for operation can be simply determined. Preliminary studies of the stability of simulator materials in the nuclear-radiation environment of the chamber are also reported. In addition, the multiple-source concept supplying a single collimator, and the problems associated with refracting vs. reflecting elements are analyzed. Author

29 SPACE SCIENCES

Includes: space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories.

For space biology see: 16 Life Sciences.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N63-16353 General Electric Co. Missile and Space Vehicle Dept., Philadelphia, Pa.

THE VENUS TERRAIN

R. W. Johnson May 4, 1962 18 p 20 refs
(R62SD153)

This report summarizes information on the environmental characteristics of Venus. Special emphasis is given to those characteristics operating to control or modify the character of the terrain and surface soil. The topics discussed are the atmosphere, climate, hydrographic features, physiographic features, soils, and soil-forming processes of Venus. Conclusions are made regarding the probable type and character of the terrain on Venus, based on analysis of known and inferred environmental data. Author

N63-16429 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A REVIEW OF GEODETIC PARAMETERS

William M. Kaula Washington, NASA, May 1963 11 p 28 refs
(NASA TN D-1847)

It is recommended that the parametric values which are currently most used in orbital computation be adopted as provisional standards, rather than those which may be the best available, because the "most used" values differ only slightly from the "best" values, and further improvements in the values are expected within the next 4 years. Author

N63-16441 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A SEARCH FOR WATER VAPOR AND TRACE CONSTITUTENTS IN THE VENUS ATMOSPHERE
Hyron Spinrad Oct. 1, 1962 9 p 13 refs
(NASA Contract NAS7-100)
(JPL-TR-32-256) OTS: $1.10 ph, $0.80 mf

An unsuccessful spectroscopic search for water vapor and other gases in the Venus atmosphere is described. The resulting upper limit on the Cytherean water vapor/atmosphere mixing ratio down to a level of high temperature and pressure is about 10^{-5} Author

N63-16444 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SOME GEOLOGIC PROBLEMS OF MARS
Alden A. Loomis Mar. 4, 1963 22 p 37 refs
(NASA Contract NAS7-100)
(JPL-TR-32-400) OTS: $2.60 ph, $0.80 mf

Geological and geophysical knowledge and uncertainties concerning the surface and body of Mars are briefly discussed and evaluated. The large number of uncertainties in present data precludes an adequate model of Mars; reliable data are needed. Some geological inferences which can be drawn from available photographic and photometric data concerning topography, areas of water accumulation, and biological activity are discussed. The priority of scientific geologic experiments is presented, and some present instrumentation capabilities and deficiences are listed. Author

N63-16513 Manchester U. (Gt. Brit.)
LUNAR INFRA-RED MEASUREMENTS Technical Note No. 2
R. Sternberg Oct. 1962 67 p
(Contract AF 61(052)-400)
(AFCRL-63-459)

Following the successful development of techniques for producing multilayer interference filters for the infrared out to 20μ, a radiometer was designed and constructed to make observations of the moon in the atmospheric window 8μ to 13μ, using the 50-inch telescope at Asiago. The primary aim was to use this instrument to determine the emissivity of the lunar surface by measuring the radiant flux from the moon in two or more narrow spectral regions within this band. Due to unusually unfavorable weather conditions during the first expedition, this objective could not be achieved. However, a number of anomalous temperature distributions were found, which appear to be associated with ray craters. Author

N63-16551 RAND Corp., Santa Monica, Calif.
A BRIEF SURVEY OF TRAJECTORY, GUIDANCE, AND PROPULSION ASPECTS OF ORBITAL RENDEZVOUS
H. B. Schechter May 1963 54 p 16 refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3275-PR)

This memorandum summarizes some aspects of the problem of orbital rendezvous that have emerged from a survey of the open literature. The papers studied are discussed briefly, and some of the interesting results and data are compared. Most of the papers can be grouped into either of two classes: The first class tackles the problem from the point of view of impulsive Keplerian orbital transfers; the second class analyzes the terminal portion of the rendezvous maneuver, or more specifically, the selection of thrusting and guidance laws required to insure a soft contact between the maneuverable interceptor and the target satellite. The survey pointed out the need for a more general parametric study of the terminal phase of orbital rendezvous; in particular, optimal guidance laws. Author

N63-16558 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
JET PROPULSION LABORATORY LUNAR PROGRAM GUIDELINES
C. I. Cummings Aug. 15, 1962 34 p
(NASA Contract NAS7-100)
(JPL-EPD-22; NASA-CR-50076) OTS: $3.50 ph, $1.22 mf

The technical and scientific objectives of the lunar program are discussed, together with the overall mission plans, phasing schedules, organization, funding, and support activities. The technical objectives are to design, develop, and demonstrate the use of unmanned spacecraft systems capable of performing the required missions. The fundamental scientific objectives are (1) gathering information on those characteristics of the lunar environment essential to successful operation of subsequent manned and unmanned missions and (2) measuring those characteristics of the moon and its environment which will provide a better understanding of the origin, history, and nature of the moon, and, indirectly, of the whole solar system. M.P.G.

N63-16575 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON A MODIFICATION OF HANSEN'S LUNAR THEORY
Peter Musen Washington, NASA, June 1963 33 p 9 refs
(NASA TN D-1745) OTS: $1.00

A modification of Hansen's lunar theory is given in a form that permits a purely numerical treatment of solar perturbations of planetary satellites or of perturbations caused by the earth in the motion of hypothetical lunar satellites. The development of the coordinates and of the velocities of a satellite is obtained in the form of a trigonometric series in four arguments with numerical coefficients. At the earlier stages of the computation, it is not compulsory to use Hansen's basic W-function: Use is made of the fictitious mean anomaly and the replacement "bar" operation—two characteristic features of Hansen's theory—to set up a process of iteration in a convenient form, rather than to compute W. The preference given to the method of iteration was motivated by the circumstance that input information must not necessarily be limited to the choice of the rotating ellipse as an intermediary orbit. A systematic investigation of the orbital stability of lunar satellites can be based on the development given here. Author

N63-16637 Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.
MICROMETEORITE COLLECTION FROM A RECOVERABLE SOUNDING ROCKET, I
C. L. Hemenway, E. F. Fullam (Dudley Obs.), S. A. Chrest, J. Frissora (Northeastern U.), R. K. Soberman, and T. G. Ryan *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 89–92 (See N63-16627 14-01) GPO: $2.75

The "Venus Flytrap" micrometeorite collector rocket was fired from White Sands, N. Mex., on June 6, 1961, at 05:31 a.m. local time. Specially prepared particle impactors were exposed between the altitudes of 88 and 168 kilometers and successfully recovered. The rocket design and performance are discussed. The

experimental surfaces consisted of 0.24 square meter of 6-micron-thick Mylar foil for impact and cratering studies, and 0.13 square meter of sealed boxes which were loaded with high-purity materials and surfaces suitable for electron microscopy. In all, eight different materials were used to permit an evaluation of the effectiveness of different materials and techniques for the collection and study of micrometeoritic particles. Some of these materials were shadowed with aluminum before and after the flight to aid in the discrimination of micrometeorite particles from contaminants. Author

N63-16638 Air Force Cambridge Research Labs. Geophysics Directorate, Bedford, Mass.

MICROMETEORITE COLLECTION FROM A RECOVERABLE SOUNDING ROCKET, II

R. K. Soberman (Northeastern U.), J. J. Balsamo (Control Equipment Corp.), D. Hallgren (Ernest F. Fullam, Inc.), C. L. Hemenway, E. F. Fullam, J. Cole, P. Yedinak, A. Goodman, and G. Hoff (Dudley Obs.) *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 93–98 (See N63-16627 14-01) GPO: $2.75

Three independent electron microscopes and observer teams have been used to evaluate, count, electron micrograph, and measure the micrometeorite particles. Typical particles and size distributions are shown. Particles have been found in structure and sizes similar to those obtained at lower altitudes with U-2 aircraft and balloon collection techniques. Approximately seven particles per square millimeter were collected during the flight. Most of the particles were submicron in size. The micrometeorite particles collected generally fell into three types: high-density spheres; medium-density irregular particles; and extremely irregular medium-density particles (fluffy particles). Some of the larger particles had sufficient momentum to rupture exposed films. Laboratory and nose-cone control surfaces were carefully studied to permit identification of micrometeorite particles. Author

N63-16639 Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.

MICROMETEORITE COLLECTION FROM A RECOVERABLE SOUNDING ROCKET, III

R. K. Soberman and C. L. Hemenway (Dudley Obs.) *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, Held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 99–103 3 refs (See N63-16627 14-01) GPO: $2.75

The interpretation is given of the preliminary results obtained from the "Venus Flytrap" rocket. These results are compared with those from satellite observations. The possible existence of a dust layer is discussed. Author

N63-16640 Academy of Sciences (USSR), Moscow

ROCKET AND SATELLITE STUDIES OF METEORIC DUST

T. N. Nazarova *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 105–108 12 refs (See N63-16627 14-01) GPO: $2.75

An investigation of meteoric dust carried out by Soviet geophysical rockets, artificial earth satellites, and space probes is presented. The determination of particle impact rate is discussed. An attempt is made to explain the existence of the dust cloud about the earth. N.E.A.

N63-16655 Smithsonian Astrophysical Observatory, Cambridge, Mass.

METEORITIC EROSION IN SPACE

Fred L. Whipple (Harvard Coll. Obs.) *In its* Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 239–248 32 refs (See N63-16627 14-01) GPO: $2.75

Photographic meteor studies and spallation products of cosmic rays in meteorites provide upper limits or evaluations of erosion rates for meteoroids in orbit. The rate increases by several orders of magnitude in the sequence: irons, stones, and photographic meteoroids. The sequence suggests that the erosion rate depends in some inverse fashion upon the strength or brittleness of the materials, a natural expectation if erosion is produced by crater-forming impacts with interplanetary dust. On this assumption and by applying Öpik's high-velocity impact theory, the author derives a mean space density for the dust at roughly 10^{-21} gm cm^{-3}. Only the very smallest cometary meteoroids can spiral into the sun by the Poynting–Robertson effect if the assumptions of this paper are true. Strong evidence for a high concentration of dust in the earth's immediate vicinity suggests that erosion rates may be greater near the earth than in deep space from Venus to Mars and even beyond. The surface of space vehicles should be carefully chosen or protected to minimize etching by interplanetary dust, if long exposure times are anticipated. The hazard may be greatest at the moon's surface. Author

N63-16658 Czechoslovak Academy of Sciences. Astronomical Inst., Ondrejov

ATMOSPHERIC TRAJECTORIES OF TELESCOPIC METEORS

Luboš Kohoutek and Jiří Grygar *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 259 3 refs (See N63-16627 14-01) GPO: $2.75

The following values were obtained—for the height of the beginning, $H_b = 98 \pm 4$ km, the center, $H_c = 93 \pm 4$ km, and the end of meteor paths, $H_e = 88 \pm 3$km—by double-station observations at Mount Bezovec. The observed beginnings of meteor trajectories were found to agree with the theoretical points of the beginning of rapid evaporation, the centers of paths corresponded to the point of maximum light of meteors, and the increase of the mean height with magnitude is very slight in the magnitude interval from 0^m0 to 7^m0. No meteor with a real height below 60 km was recorded. The mean geocentric velocity was calculated and the average original radius of the meteoroids was 0.4 to 0.5 mm. The energy necessary for the evaporation of 1 gm of meteor material was 1.6 to 3.5×10^{10} erg/gm, leading to the hypothesis that free molecular flow occurs during the flight of telescopic meteoroids through the atmosphere. D.E.R.

N63-16663 Smithsonian Astrophysical Observatory, Cambridge, Mass.

DYNAMICAL EVOLUTION OF THE PERSEIDS AND ORIONIDS

Richard B. Southworth (Harvard Coll. Obs.) *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 299–303 9 refs (See N63-16627 14-01) GPO: $2.75

This report sketches the methods used and the conclusions drawn, to date, in a study of the effects of planetary perturbations on meteor streams. The reference orbits of the Perseid and the Orionid meteor streams have been calculated. It is concluded that

the perturbations of individual meteors in a stream can be more important than the secular perturbations of the stream as a whole. The dust outbursts from comets deserve attention as possible sources of meteor streams. D.E.R.

N63-16665 National Planning Inst., Cairo (Egypt)
A SHORT NOTE ON THE ORIGIN AND AGE OF THE QUADRANTIDS
S. E. Hamid and Mary N. Youssef *In* Smithsonian Astrophys. Obs. Proc. of the Symp. on the Astronomy and Phys. of Meteors, held at Smithsonian Astrophys. Obs., Cambridge, Mass., Aug. 28–Sept. 1, 1961 1963 p 309–311 2 refs (See N63-16627 14-01) GPO: $2.75

The Quadrantid meteor shower is distinguished among the periodic meteor streams by its very short duration ($<1°$ in longitude of node), high inclination ($\simeq 70°$), short period ($\simeq 5$ years), and high eccentricity ($\simeq 0.70$). The orbital elements of six doubly photographed meteors of this shower are presented. The secular perturbation of Jupiter on these orbits is integrated numerically. It is found that the inclination of the stream decreases from its present high value to a minimum value ($\simeq 13°$) around 1500 years ago and then increases again to a maximum ($\simeq 76°$) around 4000 years ago; the perihelion distance of the stream decreases from its presented value ($\simeq 1$ a.u.) to a minimum value (<9.1 a.u.) around 1500 years ago (time of minimum inclination), and then increases again to maximum ($\simeq 1.0$ a.u.) around 4000 years ago (time of maximum inclination); the stream recedes from Jupiter's orbit; arrives at its maximum distance about 1500 years ago, and then approaches Jupiter's orbit again to within 0.2 a.u. about 4000 years ago; and the longitude of the perihelion of the stream undergoes periodic variation with its minimum value $\simeq 86°$ around 500 years and its maximum value $\simeq 111°$ around 2800 years. Typical changes of the orbital elements of a Quadrantid meteor are presented in tabular form and an hypothesis is presented that a comet captured by the planet Jupiter some 4000 years ago developed meteors along its path. Because an appreciable number of them which now form the Quadrantids did not suffer another close approach to Jupiter, the Quadrantid shower is now observed to be compact. D.E.R.

N63-16674 National Aeronautics and Space Administration, Washington, D.C.
INTERNATIONAL COOPERATION IN SPACE RESEARCH
Arnold W. Frutkin Repr. from Astronautics and Aerospace Eng., Mar. 1963 7 p

This review of international cooperation in space includes: (1) the extent to which cooperation in space research actually exists today among the nations; (2) the Soviet Union's record of cooperation in space research; (3) the status of bilateral negotiations between the U.S. and the U.S.S.R.; 94) the role of the United Nations with regard to outer space; (5) the existence of tangible benefits from international cooperation in space research; and (6) the problems affecting the extension of cooperation across national boundaries. I.v.L.

N63-16684 Observatorium Bosscha, Bandung (Indonesia)
CORRECTION OF BACKGROUND EFFECT IN PHOTOGRAPHIC PHOTOMETRY
K. Purbosiswojo Feb. 1963 15 p 4 refs
(*Its* Contribution No. 18)

A method to correct photographic magnitudes of stars embedded in nebulosities, measured by making use of Eichner-photometers, is presented. An application of the method was carried out on the Galactic Cluster NGC 6530 for the photometer of Warner and Swasey Observatory. The method is also applicable on parts of photographic plates in which background-emulsion densities differ from that of the region of the standard sequence. Author

N63-16693 Observatorium Bosscha, Bandung (Indonesia)
FAINT Hα-EMISSION OBJECTS IN NEBULOSITIES SURROUNDING THE STAR m Cen.
Pik-Sin The Nov. 1962 19 p 10 refs
(*Its* Contribution No. 17)

A survey of emission Hα-objects in a region of dark and bright nebulosities in the neighborhood of m Cen yields the discovery of 78 new Hα-emission stars and two planetary nebulae. The center of this region is at R.A. = $13^h\ 04^m$; Dec. = $-63°\ 30'$ (1875). Approximate positions, V magnitudes, and V-R colors have been determined. Finding charts for the emission Hα-objects are given. Among the emission stars, 12 turn out to be suspected variables. This supports the belief that part of the fainter emission stars probably form T-associations which are connected with the nebulosities, and which might also be related to the OB-association I Cru. Author

N63-16697 National Aeronautics and Space Administration, Washington, D.C.
INTERNATIONAL COOPERATION IN SPACE: WHAT'S BEING DONE? WHAT OF THE FUTURE?
Arnold W. Frutkin Repr. from Vital Issues, v. XII, no. 8, Apr. 1963 p 1–4
Available from Center for Inform. on Am., Washington, Conn: $0.35

In the past year, substantial evidence of the feasibility, the benefits, and the promise of joint action by the nations in this new field has been gained. Discussions are presented of the developments along these lines which have occurred in the following different sectors: the international programs of the National Aeronautics and Space Administration (NASA), the establishment of regional space organizations in Europe, the achievement of an unprecedented agreement between the U.S. and the U.S.S.R. for coordinated space research, the new coordinated programs of the organized international science community, and the constructive action of the United Nations. I.v.L.

N63-16699 National Aeronautics and Space Administration, Washington, D.C.
[FAITH 7] Press Conference No. MA-9
May 19, 1963 22 p
OTS: $2.60 ph, $0.86 mf

The report presents an account to the press by Major Gordon Cooper of his space flight in Faith 7. I.v.L.

N63-16700 National Aeronautics and Space Administration, Washington, D.C.
ORBITING SOLAR OBSERVATORY FIRST OF THE "STREETCAR" SATELLITES
Washington, NASA. Office of Educational Programs and Services [1963] 1 p
(NASA FACTS (B-62)) GPO: $0.15

The first orbiting solar satellite (OSO) is a 458-pound spacecraft, containing 13 scientific solar experiments, traveling in a 350-mile-high, 96-minute, earth orbit. This spacecraft utilizes available solar properties to obtain data on the sun's origin, development, and constantly changing character. Knowing from optical and radio detectors on earth when solar storms and flares are occurring, scientists can analyze and contrast OSO's data, before, during, and after known events, to discover laws and principles about the sun's composition, its solar storms and flares, and their influence on the earth and on spacecraft. The 13 experiments are divided into two groups: 5 on the fan-shaped upper portion constantly facing the sun, and 8 in the rotating wheel or lower

portion of the satellite. The former are sun-pointing tests, establishing standards of solar activity during quiet and turbulent periods. The wheel experiments are sky-mapping activities comparing radiations directly from the sun with those from other areas in space. I.v.L.

N63-16701 National Aeronautics and Space Administration, Washington, D.C.
NASA'S RANGER PROGRAM
Washington, NASA. Office of Educational Programs and Services [1963] 1 p
(NASA FACTS (A-62)) GPO: $0.15

The Ranger program represents America's first attempt to obtain closeup and detailed photographs of the moon and its topography, to secure scientific data on the composition of the lunar surface, and to learn more about lunar origin, history, and structure from an instrumented capsule designed to survive a "rough landing" on the moon. In this report, the development of the Ranger project, the Ranger flight plan, and Ranger test flights are discussed. Highlighted are the results, and their implication, as follows: (1) the successful accomplishment of its solar panels lock on the sun, simultaneous with the earth-orientated lock of its high-gain antenna (this was a truly FIRST and will contribute enormously to improved reception of telemetered scientific data from spacecraft); (2) the gamma-ray detector, operating for 50 hours, that provided some 350 reports on the environment through which Ranger III passed on its way toward the moon. I.v.L.

N63-16702 California Inst. of Tech. Div. of Geological Sciences, Pasadena
THE STABILITY OF VOLATILES IN THE SOLAR SYSTEM
Kenneth Watson, Bruce Murray, and Harrison Brown. Repr. from Icarus, v. 1, no.4, Jan. 1963 p 317–327 18 refs
(NASA Grant NsG-56-60)

The previous study of the stability of ices of common volatiles (water, ammonia, carbon dioxide, and methane) on the surface of the moon has been extended to other surface environments in the solar system. A spherical body composed of a mixture of these ices is considered; initially considered is the stability of such spheres at heliocentric distances of 1 to 10 a.u. These results are then applied to an examination of the stability of ices in the rings of Saturn, on the surfaces of the smaller satellites of Jupiter and of Saturn, and finally to bodies in orbits similar to those of short period comets. Author

N63-16703 Calif. Inst. of Tech., Pasadena
STELLAR AND PLANETARY OBSERVATIONS AT 10 MICRONS
Bruce C. Murray and Robert L. Wildey Repr. from Astrophys. J., v.137, no. 2, Feb. 15, 1963 p 692–693 3 refs
(NASA Grant NsG-56-60; NSF-G-25210)

A specially designed 19-inch portable infrared telescope and photometer system utilizing a mercury-doped germanium detector operated at liquid-hydrogen temperature was used to make observations of the Moon, Saturn, Jupiter, and α Orionis. Measurements were obtained by an a.c. amplification of the difference in voltage produced by the radiation incident on the detector from two different optical paths, one from the object being measured and the other from the adjacent sky. Extinction corrections were scaled down from Palomar in proportion to pressure. New lunar and planetary radiometric brightness temperatures, together with the first reported measurement of 10μ radiation from an object (α Orionis) outside the solar system, were obtained. I.v.L.

N63-16709 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONTINUOUS AND DEGENERATE GRAVITATING SYSTEMS
R. G. Langebartel Oct. 8, 1962 61 p 11 refs
(NASA TM X-50022; NASA-X-520-62-170) OTS: $6.60 ph, $2.03 mf

The methods of statistical mechanics used in stellar dynamics are combined with the methods of Schwartz distribution theory to treat various types of continuous and discontinuous media. The motion is considered in phase space. One example is that of a medium continuous in position space but discrete in velocity space. Another example is that of a medium discrete in both position and velocity space, i.e., the n-body problem. Thus, this presents for celestial mechanics an alternative method to the classical one. Author

N63-16726 Columbia U., New York, N.Y.
REPORT ON THE 1962 SUMMER INSTITUTE IN SPACE PHYSICS, HELD AT COLUMBIA UNIVERSITY, JULY 2-AUGUST 10, 1962
J. E. Nafe and Robert Jastrow [1962] Repr. of *its* Report 20 p
(NASA Grant NsG-229-62)
(NASA-CR-50131)

The principal activity of the Summer Institute was a course of lectures in which physics, astronomy, and the earth sciences were synthesized into a physical description of the areas of space research. The last week of the session consisted of a field trip to NASA facilities at Huntsville, Cape Canaveral, and Greenbelt, which acquainted the participants with some of the technical and experimental realities of the space program. The participants in the Summer Institute included 58 students from colleges and universities in the U.S., 18 European students, and 4 representatives of NASA centers. M.P.G.

N63-16731 Cornell U. Center for Radiophysics and Space Research, Ithaca, N.Y.
STRUCTURE OF THE MOON'S SURFACE
T. Gold Apr. 1963 11 p Presented at the Am. Geophys. Union, Apr. 1963 Submitted for Publication
(NASA Grant NsG-382)
(NASA-CR-50117; CRSR-140) OTS: $1.60 ph, $0.80 mf

This report describes the moon's surface as consisting of fine powders (fluffy material). The generation of this fluffy surface material should be thought of as connected with local processes on the surface rather than with a general blanketing by micrometeorites or by volcanic ash or by all the ray material ejected from all the craters. For in all the cases of general blanketing, no explanation would remain for the characteristic color differentiation whereby the high ground is generally lighter than the low ground. The conclusion that both ought to be the same color because they are the same material can be avoided if the underdense surface is generated, at least in part, from local "stuff" rather than from a general blanket. I.v.L.

N63-16741 Virginia Polytechnic Inst., Blacksburg
THE TORQUE AND ANGULAR VELOCITY INDUCED BY THE GEOMAGNETIC FIELD ON A SPINNING CONDUCTING SATELLITE
G. Louis Smith (M.S. Thesis) May 1963 81 p 8 refs

One source of torque on near-earth satellites is the interaction of the earth's magnetic field with eddy-currents induced in the electrically conducting parts of a spinning satellite. This thesis presents an analysis of this torque, and the resulting spin motions. The electromagnetic field equations are applied to spinning and tumbling cylinders, and spinning thin-wall cones, cone frustums, and the general body-of-revolution. The eddy

currents are thus determined for each case, and from this the torque is calculated. The torque which acts on a spinning satellite while in orbit is studied. An expression is derived for the torque vector as a function of the orbit parameters. The time-history of the spin vector subject to this torque is investigated. Author

N63-16777 Air Force Special Weapons Center, Kirtland AFB, N. Mex.
PACIFIC MISSILE RANGE TRAJECTORIES
Lawrence C. Callaway Feb. 1963 119 p 2 refs
(SWC-TDR-63-25)

Included in this report are studies of five ballistic trajectories for a point mass moving in three degrees of freedom relative to a rotating oblate earth. All trajectories are launched from Vandenberg AFB, California, to points of interest in the Pacific Missile Range. A running account of the position, forces exerted on the vehicle, and atmospheric information is given throughout the trajectory with a more detailed account given from reentry into the atmosphere to impact. Since it was desired to achieve a 20-degree reentry angle, these trajectories do not represent minimum energy trajectories. Reentry is considered to occur between the altitudes of 300,000 and 400,000 feet. The Standard ARDC-1959 Atmosphere Model was used in computing these trajectories. Author

N63-16802 Vanderbilt U., Nashville, Tenn.
AN APPLICATION OF CALCULUS OF VARIATIONS TO THE OPTIMIZATION OF MULTISTAGE TRAJECTORIES
M. G. Boyce *In* NASA. Marshall Space Flight Center Progress Rept. No. 3 on Studies in the Fields of Space Flight and Guidance Theory [June 15–Dec. 20, 1962] Feb. 6, 1963 p 10–28 8 refs (See N63-16801 14-01) OTS: $15.00 ph, $6.98 mf
(Sponsored by NASA. Marshall Space Flight Center)

A procedure is developed for determining a fuel-minimizing trajectory for a multistage rocket in three-dimensional space. In each stage, the fuel burning rate and magnitude of thrust are assumed constant. The motion is subject to the inverse-square gravity law but with negligible atmospheric resistance. The Euler-Lagrange equations determine minimizing trajectories in a given stage. Transversality conditions are then invoked to extend a minimizing path across the boundary to the next stage. The existence of minimizing trajectories is assumed, sufficient conditions not being investigated in this paper. Author

N63-16803 Republic Aviation Corp., Farmingdale, N.Y.
TWO-POINT BOUNDARY-VALUE PROBLEM OF THE CALCULUS OF VARIATIONS FOR OPTIMUM ORBITS
Jack Richman *In* NASA. Marshall Space Flight Center Progress Rept. No. 3 on Studies in the Fields of Space Flight and Guidance Theory [June 15–Dec. 20, 1962] Feb. 6, 1963 p 29–56 3 refs (See N63-16801 14-01) OTS: $15.00 ph, $6.98 mf
(Sponsored by NASA. Marshall Space Flight Center)

This report contains a description for the solution of the two-point boundary-value problem of the calculus of variations for optimum orbits. The method employed uses Lagrange multipliers and Pontryagin's maximum principle to obtain the decision functions. In addition, two differential correction schemes are described. The first scheme is a "method by forward integration," and the second is an alternate "method by backward integration" that attempts to reduce the difficulties that might be encountered in inverting a differential correction matrix. The optimum orbit is determined by a perturbation method similar to that of Encke and accommodates hyperbolic as well as elliptic orbits. The equations necessary for the generation of a digital-computer program are derived. Author

N63-16804 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
AN APPLICATION OF A SUCCESSIVE APPROXIMATION SCHEME TO OPTIMIZING VERY LOW-THRUST TRAJECTORIES
Gordon Pinkham *In* NASA. Marshall Space Flight Center Progress Rept. No. 3 on Studies in the Fields of Space Flight and Guidance Theory [June 15–Dec. 20, 1962] Feb. 6, 1963 p 57–62 (See N63-16801 14-01) OTS: $15.00 ph, $6.98 mf
(Sponsored by NASA. Marshall Space Flight Center)

This report describes an application of a successive approximation scheme for optimization of low-thrust trajectories involving many revolutions about a central body. The equations-of-motion, written in terms of orbital parameters rather than position and velocity components, are analyzed, and a convenient thrust formula is derived. This formula, together with the variation-of-parameters method of trajectory computation, has been programed for the IBM 7090. Author

N63-16805 Hayes International Corp., Birmingham, Ala.
ORBITAL ELEMENT EQUATIONS FOR OPTIMUM LOW THRUST TRAJECTORIES
Harry Passmore, III *In* NASA. Marshall Space Flight Center Progress Rept. No. 3 on Studies in the Fields of Space Flight and Guidance Theory [June 15–Dec. 20, 1962] Feb. 6, 1963 p 63–96 6 refs (See N63-16801 14-01) OTS: $15.00 ph, $6.98 mf
(Sponsored by NASA. Marshall Space Flight Center)

The three-dimensional optimum-trajectory relations developed by Messrs J. G. Cox and W. A. Shaw are transformed into a form that appears more amenable to low-thrust-trajectory calculations. Orbital-element coordinates, commonly used in celestial mechanics, are employed due to their slow variation in low-thrust applications. Combinations of these elements and a generalized eccentric anomaly are utilized in arranging the resulting equations in a form which does not contain circular singularities. Author

N63-16806 General Electric Co. Space Sciences Lab., King of Prussia, Pa.
ROCKET BOOSTER VERTICAL CLIMB OPTIMALITY Special Report No. 2
Carlos R. Cavoti Dec. 15, 1962 *In* NASA. Marshall Space Flight Center Progress Rept. No. 3 on Studies in the Fields of Space Flight and Guidance Theory [June 15–Dec. 20, 1962] Feb. 6, 1963 p 97–137 11 refs (See N63-16801 14-01) OTS: $15.00 ph, $6.98 mf
(NASA Contract NAS8-2600)

This paper discusses the problem of the optimum burning program for the vertical climb of a rocket. A generalized expression for the optimum burning program (or control variable program), valid for any arbitrary aerodynamic characteristics and any arbitrary atmospheric model assumed, is derived. A numerical method for determining the position of the corner points, for cases where aerodynamic drag, D = D(v,h), is discussed. Numerical examples are included. Author

N63-16807 North American Aviation, Inc. Space Sciences Lab., Downey, Calif.
RENDEZVOUS POSSIBILITIES WITH THE IMPULSE OF OPTIMUM TWO-IMPULSE TRANSFER Special Report No. 1
D. F. Bender Dec. 15, 1962 *In* NASA. Marshall Space Flight Center Progress Rept. No. 3 on Studies in the Fields of Space Flight and Guidance Theory [June 15–Dec. 20, 1962] Feb. 6, 1963 p 138–153 4 refs (See N63-16801 14-01) OTS: $15.00 ph, $6.98 mf
(NASA Contract NAS8-1582)

Two-impulse optimum orbital transfer will lead to rendezvous for only a single value of the relative positions of the ferry and target at the beginning of the maneuver. It is shown that, by the simple expedient of splitting either the first or second impulse of this optimum transfer between any two orbits and holding for one revolution in the intermediate transfer orbit so obtained, rendezvous is possible over an extended range of relative phases. A technique for generating the required data, including excess thrust tolerances for any orbit pair, is explained and sample data are presented. Author

N63-16808 Republic Aviation Corp., Farmingdale, N.Y.
APPROXIMATION OF THE RESTRICTED PROBLEM BY THE TWO-FIXED-CENTER PROBLEM
Mary Payne *In* NASA. Marshall Space Flight Center Progress Rept. No. 3 on Studies in the Fields of Space Flight and Guidance Theory [June 15–Dec. 20, 1962] Feb 6, 1963 p 154–180 3 refs (See N63-16801 14-01) OTS: $15.00 ph, $6.98 mf
(Sponsored by NASA. Marshall Space Flight Center)

A perturbation theory of the two-fixed-center problem leading to an approximation for the restricted-three-body problem is developed. It makes use of a generalization of the method developed by Schulz–Arenstorff, Davidson, and Sperling. The derivations are carried out in a coordinate system rotating about an accelerated origin, and the generalization consists of the selection of this origin in such a way as to minimize the effects of the nonintegrable terms in the perturbation equations. The results of some numerical calculations are presented. Author

N63-16834 National Aeronautics and Space Administration. Washington, D.C.
MARS—A TARGET FOR ADVANCED PROPULSION News Release
Harold B. Finger June 6, 1963 22 p Presented at the American Astronautical Soc. Symp. on the Exploration of Mars Denver, Colo., June 6–7, 1963
Available from NASA. Office of Scientific and Technical Information, Wash., D.C.

Although the mission to Mars will not be undertaken until the Apollo project begins to phase out, the importance of preparing the basic information and technology is stressed for two reasons: (1) to avoid wasteful crash programs and (2) by directing long-range interest toward Mars landing missions, the capability is provided for other missions of interest, such as orbital space stations, which are logical stepping stones to planetary missions. Since nuclear rockets will undoubtedly be used for at least the upper stages of the Mars mission, the present status of nuclear propulsion technology is discussed. The conclusion is reached that no major technological breakthrough will be required to develop a nuclear rocket patterned after the KIWI reactor now being tested. Electrical propulsion systems, although offering great potential on paper, have the engineering drawback of not being suitable for a ground development and test program. A careful, realistic determination of the areas which offer the greatest promise must be made in order to gain real accomplishments in space. M.P.G.

N63-16839 Brown Engineering Co., Inc., Huntsville, Ala.
A FORTRAN PROGRAM FOR THREE-DEGREE OF FREEDOM TRAJECTORIES, REFERENCED TO GEOCENTRIC COORDINATES AND TO AN ARBITRARY POINT ON THE EARTH'S SURFACE
H. M. Minshew May 1963 72 p 4 refs
(Tech. Note R-48)

This report describes a FORTRAN II computer program for generating synthetic ballistic-vehicle trajectories. The vehicle is considered to have a constant ballistic coefficient and to be under the influence of gravitational, aerodynamic, centrifugal, and Coriolis forces. The program contains provisions for computing the trajectory in the reference frame of an arbitrarily located radar station. Author

N63-16896 Air Force Special Weapons Center. Test Directorate, Kirtland AFB, N. Mex.
SPINNING UNGUIDED ROCKET TRAJECTORY DIGITAL COMPUTER PROGRAM (SPURT)
Allen D. Dayton Feb. 1963 214 p 19 refs
(AFSWC-TDR-63-11)

SPURT is a five-degree-of-freedom trajectory digital-computer program for spinning unguided space-probe vehicles. The program was written for the Control Data Corporation 1604 digital computer. SPURT will compute trajectories for a vehicle up to a maximum of ten stages, and has provision for computing the trajectories of the separated stages. This generalized program computes the trajectory over an oblate spheroidal, rotating earth with atmosphere, in a geocentric, rectangular, coordinate system. All input and output data are in geodetic coordinates. Coasting flight trajectories are computed in two subroutines. The first is a Keplerian solution, which also computes orbital elements and "look angles" for various tracking stations. The second uses three-degree-of-freedom point mass equations solved by numerical integration. The program will prepare two special output tapes. One is used in plotting output data and the other is used to prepare a special tape for the Atlantic Missile Range. Author

N63-16937 Sperry Gyroscope Co., Great Neck, N.Y.
RE-ENTRY STABILITY AND TRAJECTORY ANALYSIS FOR A CONICAL VEHICLE
R. Vaccaro and P. Zove Oct. 1962 77 p 10 refs
(Contract AF 04(694)-28)
(CA-4291-0065; BSD-TDR-62-315; AD-291462)

A slender conical vehicle is analyzed to determine its suitability during the reentry phase. Both theoretical analyses and a six-degree-of-freedom computer program are used in the study. Angle-of-attack convergence and time histories of the various trajectory parameters are presented. The effects of static margin, radius of gyration, and initial spin rate on the convergence envelope are also considered. A complete description of the computer program is included. Author

30 SPACE VEHICLES

Includes: launch vehicle—spacecraft combinations; operating problems; and stability and control.

For manned space capsules, satellites, and space probes see: 32 Space Vehicles (Spacecraft).

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For related information see: 04 Aircraft; 08 Communication; and 22 Navigation and Guidance.

N63-16400 General Electric Co., Evendale, Ohio
RESEARCH AND EVALUATION OF MATERIALS FOR THERMOCOUPLE APPLICATION SUITABLE FOR TEMPERATURE MEASUREMENTS UP TO 4500°F ON THE SURFACE OF GUIDE RE-ENTRY VEHICLES [Final Report, Mar. 15, 1962–Mar. 15, 1963]
W. C. Kuhlman Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, May 1963 83 p
(Contract AF 33(657)-8472)
(ASD-TDR-63-233)

The thermoelectric output versus temperature of a W/W-26Re thermocouple was measured to 5800° F. Thermoelectric sensitivity was relatively high over the entire temperature range. Of the alloys studied, Re-10Ru and Re-12W show the greatest potential for high-temperature thermocouple application. The oxides, BeO, ThO_2, and HfO_2, are compared as electrical insulators. Beryllia is best, but with proper geometry ThO_2 and HfO_2 would also be satisfactory. Boron nitride was found to react with W and W-26Re materials above 3700° F in helium. The melting points of many rare earth oxides, zirconates, and hafnates were determined. Weight loss of Ir, Ir-10Re, OS, Ir-15Os, and Ir-20Os at 0.1 atmosphere pressure at approximately 4400° F was measured. The test shows that Ir-20Os alloy, with a measured melting point at 4600° F, should make satisfactory sheathing material for short-time service. Author

N63-16424 National Aeronautics and Space Administration. Launch Operations Center, Cape Canaveral, Fla.
LAUNCHING THE MOON ROCKET
Kurt H. Debus Repr. from Astronautics and Aerospace Eng., Mar. 1963 p 20-32

The management responsibility for the manned lunar landing program is outlined with emphasis placed on the launch facilities and the Saturn C-5 or Saturn V rocket to be used to launch the Apollo vehicle. The LC-39 complex of launch facilities is explained and its various subsystems are noted; e.g., the automatic checkout, vehicle movement to multipad complex, and remote control of the launch itself. Illustrations are included of the mobile arming tower, missile transporter, vehicle assembly building, and the pad area. D.E.R.

N63-16445 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A SIMPLIFIED STATISTICAL MODEL FOR MISSILE LAUNCHING-1
Carleton B. Solloway May 1, 1963 11 p
(NASA Contract NAS7-100)
(JPL-TR-32-431(Pt. 1) OTS: $1.60 ph, $0.80 mf

This report is the first of a series dealing with the problem of estimating the number of days necessary to complete the countdown procedures for the launching to three vehicles from two launch pads. Various assumptions are made about the manner in which the countdown procedures are conducted and the nature of the delays encountered. Author

N63-16481 General Motors Corp. Aerospace Operations Dept., Santa Barbara, Calif.
INVESTIGATION OF FUNDAMENTAL MECHANISM OF DAMAGE TO THIN TARGETS BY HYPERVELOCITY PROJECTILES
C. J. Maiden Mar. 1963 80 p 14 refs
(Contract Nonr-3891(00)(X); Proj. Defender)
(TM63-201)

The objective of this program is a detailed study of the mechanisms of penetration, perforation, and spalling of a thin target caused by the impact of a hypervelocity projectile. Thin targets of various materials and thicknesses have been impacted with projectiles through a wide range of velocities. A physical model of the phenomena of hypervelocity impact has been obtained and is presented, together with a comparison of the predicted and actual results. Author

N63-16671 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ORBIT-LAUNCHED NUCLEAR VEHICLE DESIGN AND PERFORMANCE EVALUATION PROCEDURE FOR ESCAPE AND PLANETARY MISSIONS
Ronald J. Harris and Robert E. Austin Nov. 8, 1962 76 p 6 refs
(MTP-P&VE-F-62-11; NASA TM X-50003) OTS: $7.60 ph, $2.48 mf

A comprehensive procedure is described, and reference data presented, by which the effect of certain design parameters upon the basic performance of orbit-launched nuclear vehicles can be readily determined for escape and planetary missions. The performance parameters investigated are payload ratio, propellant ratio, characteristic velocity requirement, burning time, injection altitude, central angle and flight-path angle. The effects of initial thrust-to-weight ratio, initial altitude, specific impulse, specific weight factors, and hyperbolic excess velocity are considered. The range of specific impulse assumed is restricted to that considered practical for nuclear heat-exchanger propulsion systems. Author

N63-16770 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
IMPEDANCE CONSIDERATIONS IN VIBRATION TESTING
L. J. Pulgrano *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1-4, 1962 Mar. 1963 p 236-244 4 refs
This paper was not presented at Symp. (See N63-16750 14-01)

The assumption of negligible specimen impedance inherent in the motion-input approach to vibration testing is often unsatisfied. In this paper, the significance of this assumption is illustrated by considering the relationship between the operational environment and a motion-input test environment for a spacecraft-launch-vehicle system in which the spacecraft impedance is appreciable. Author

N63-16794 Lockheed Missiles and Space Co., Sunnyvale, Calif.
GUIDANCE PROGRAM FOR RENDEZVOUS OF TWO VEHICLES AT A PRESELECTED LOCATION ABOVE THE EARTH
P. J. Douglas and J. R. Phillips [1962] 10 p 1 ref
(LMSC-A372006; IDC-53-73-17)

Given the position and velocity of two orbiting satellites at a particular time, and either the time to rendezvous, or both the time to rendezvous and the rendezvous location, the program determines the maneuver requirements for one vehicle, necessary to achieve rendezvous. This paper describes, in general, the operation and capabilities of the computer program for use in the Gemini program. Author

N63-16800 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PREDICTION AND MEASUREMENT OF NATURAL VIBRATIONS OF MULTISTAGE LAUNCH VEHICLES
Vernon L. Alley, Jr., and Sumner A. Leadbetter Repr. from AIAA Journal, v. 1, no. 2, Feb. 1963 p 374-379 1 ref Presented at the ARS Launch Vehicles: Structures and Materials Conf., Phoenix, Ariz., Apr. 3-5, 1962

The results of an analytical and experimental study to determine the first three natural frequencies of a four-stage research rocket are presented. A matrix recurrence equation is given which provides a convenient means for solving for the fundamental and higher modes of oscillation of the structure. Vibration tests were performed in a vertical fixture that afforded good unrestrained characteristics in one plane of motion. The results of studies of the effects of looseness in interstage connections, the unsymmetric behavior of a supposedly symmetrical structure, nonlinear characteristics, and an empirical treatment of joint flexibility are discussed. Good agreement between the calculated and measured data is shown. Author

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes: boosters; clustered rockets; and multistage rockets.

For propulsion engines see: 27 Propulsion.

For launch vehicle - spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

No abstracts in this issue.

32 SPACE VEHICLES (SPACECRAFT)

Includes: manned space capsules; satellites; and space probes.

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For Launch vehicle—spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-16386 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

THE MISSION OF MARINER II: PRELIMINARY OBSERVATIONS

James A. Van Allen and Louis A. Frank (Iowa U.), W. M. Alexander (NASA. Goddard Space Flight Center), P. J. Coleman, Jr. (Calif. U.), C. P. Sonett (NASA. Ames Research Center), Neugebauer, Conway W. Snyder, Leverett Davis, Jr., E. J. Smith, and Hugh R. Anderson Repr. from Science, v. 139, no. 3549, Jan. 4, 1963 10 p 22 refs

(TR32-383)

Data is presented on the solar plasma experiment, the Iowa experiment, the cosmic dust experiment, the interplanetary magnetic fields experiment, high-energy-radiation experiment, and the electromagnetic radiation from Venus experiment compiled from data received from the mission of the Mariner II interplanetary space vehicle. Included are significant events in the voyage of the Mariner II with the time and distance from the spacecraft to the earth recorded. N.E.A.

N63-16535 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.

A STUDY OF THE STABILIZATION OF AN EARTH SATELLITE

Francois A. Jazede Oct. 1962 34 p 6 refs

(Grant DA-ARO(D)-31-124-G144)

(PIBMRI-1079-62; AROD-1538-22)

This study is concerned with the stabilization in attitude of an earth satellite. In particular, two ways of obtaining good stabilization are studied. One, by use of a gas rocket, which yields a nonlinear system ("On-Off" type) studied by the phase plane method. The other, by use of flywheels; the stabilization is then a linear one. In both cases, it is shown that a great simplification can be introduced in the stability equations by the introduction of some approximations. Even in the nonlinear case, the approximations (practically always justified) bring an enormous simplification in the computations by suppressing the coupling between the three axes around which the stabilization is applied. Author

N63-16563 National Aeronautics and Space Administration. Washington, D.C.

MARINER II REPORTS

Washington, NASA. Office of Educational Programs and Services [1963] 1 p

(NASA FACTS-B-4-63) GPO: $0.15

Highlights of the new scientific knowledge gained through analyses of the voluminous quantities of data received from the Mariner II space vehicle and from earth-based experiments carried out in conjunction with the spacecraft's activities are presented. Included are: the general geomorphology of Venus, the absence of a magnetic field and radiation belt around Venus, the presence and composition of a solar wind in interplanetary space, the universal magnetic fields in space, cosmic radiation, micrometeoroid impact count, tracking data, communications records, and the midcourse maneuver of Mariner II. D.E.R.

N63-16600 National Aeronautics and Space Administration. Washington, D.C.

A-R-I-E-L FIRST INTERNATIONAL SATELLITE

Washington, NASA. Office of Educational Programs and Services [1962] 1 p

(NASA FACTS C-62) GPO: $0.50

Ariel, the joint United Kingdom–United States satellite, a project consisting of a NASA Delta launch vehicle coupled with British Ariel payload rockets, is presented in this report. The satellite hurled into orbit through this effort weighs 132 pounds, and is 23 inches in diameter. In orbit, with solar cell paddles, booms, and antennas extended, it measures about 10 feet across. The chief objective of Ariel is to contribute to the knowledge of the ionosphere by measuring densities and temperatures of electrons, and characteristics, quantity, and distribution of ions. C.L.W.

N63-16696 National Aeronautics and Space Administration. Washington, D.C.

1-2-3 AND THE MOON: PROJECTS MERCURY, GEMINI, AND APOLLO OF AMERICA'S MANNED SPACE FLIGHT PROGRAM

[1963] 32 p

(NASA EP-7)

The Mercury, Gemini, and Apollo projects and spaceflights are explained and their relation to the United States' hope of a manned lunar landing project is given. Topics include: launch procedures and control of the flight, orbital rendezvous, lunar explorations, unmanned spaceflights in preparation for project Apollo, and the facilities and command of the American space program. D.E.R.

N63-16748 National Aeronautics and Space Administration. Washington, D.C.

FLIGHT PROGRAM

Nancy G. Roman Repr. from Astronomical J., v. 67, no. 9, Nov. 1962 p 655–658 refs

The first Orbiting Solar Observatory; experimental plans for the second Orbiting Solar Observatory; the launch, orbiting, and recovery of two manned spacecrafts; and experiments of the Explorer XI satellite are discussed as part of the spaceflight program. Theoretical and laboratory studies in space research at various research centers are included. N.E.A.

N63-16756 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
DEVELOPMENT OF VIBRATION DESIGN PROCEDURES FOR THE ORBITING ASTRONOMICAL OBSERVATORY
Bernard Shatz and Murray Bernstein *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 77–87 4 refs (See N63-16750 14-01)
(Supported by NASA)

This paper presents analytical and experimental procedures used to assure the adequacy of the spacecraft structure and equipment under the vibration requirements of the NASA Environmental Test Specification. Author

N63-16972 National Aeronautics and Space Administration, Washington, D.C.
SYSTEMS CHECKOUT FOR APOLLO
J. E. Sloan and J. F. Underwood Repr. from Aeron. and Aerospace Eng., Mar. 1963 p 37–40

Factors that affect requirements at all points of checkout operations are outlined: overall mission requirements, the nature of the equipment undergoing checkout, the ability to take corrective action based on checkout data, and technical feasibility constraints in providing reliable checkout equipment. The factors are studied with regard to the Apollo vehicle and an operational checkout approach is designed. This approach emphasizes: (1) quick response time, (2) simplified go–no-go control and display devices, (3) automatic and semiautomatic checkout and launch control equipment, (4) operational methods and procedures minimizing technical personnel in the launch crew, (5) an operating philosophy that establishes statistical confidence levels consistent with operational requirements. However, the NASA Apollo checkout must also use the manual techniques used for other space projects. D.E.R.

33 STRESSES AND LOADS

Includes: fatigue; vibration; flutter; and structural tests.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 34 Structural Design.

N63-16396 General Electric Co. Research Lab., Schenectady, N.Y.
DELAYED FAILURE OF POLYCRYSTALLINE AND SINGLE-CRYSTAL ALUMINA
R. J. Charles and R. R. Shaw July 1962 44 p 26 refs
(Rept. 62-RL-3081M)

Both single-crystal sapphire and polycrystalline alumina exhibited strong delayed-failure characteristics which depended on atmosphere, temperature, and strain rate. Delayed failure was absent at liquid-nitrogen temperatures, most readily observable around room temperature, and decreased with further increases of temperature until at 900° C it was no longer observable. A very rapid decrease of observed strength of the ceramics with increasing temperature (to 900° C) was observed. A fatigue theory involving stress corrosion of an elastic continuum has been applied to the low-temperature experimental data on sapphire. Reasonable values for the parameters involved in the theory were obtained. Author

N63-16442 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
VIBRATION OF THIN CIRCULAR RINGS. PART II. MODAL FUNCTIONS AND EIGENVALUES OF CONSTRAINED SEMI-CIRCULAR RINGS
T. E. Lang Mar. 1, 1963 50 p
(NASA Contract NAS7-100)
(JPL-TR-32-261) OTS: $4.60 ph, $1.70 mf

The equations-of-motion of thin circular rings are derived and solved for in-plane inextensional deformation. Modal characteristics are tabulated for the five lowest flexural modes of vibration of semicircular ring segments for the possible combinations of homogeneous boundary conditions that can occur. Author

N63-16480 Rheinisch-Westfälische Technische Hochschule, Inst. für Turbomaschinen, Aachen (W. Germany)
INVESTIGATION OF THE GENERAL STRESS DISTRIBUTION IN IMPELLER WHEELS [Final Report, Apr. 1961–Dec. 1961]
Wilhelm Dettmering and Wilhelm Soetebeer Wright-Patterson AFB, Ohio, Directorate of Mater. and Processes, Mar. 1963 72 p 39 refs
(Contract AF 61(052)-520)
(ASD-TDR-62-1013)

The first part of this report is a detailed description of the available calculation data for rotating shells. The second part of the report covers the elucidation and display of theoretical calculation results. In particular, such different influences as the number of blades, plane temperature fields, varying shell slopes, etc., were examined. The third part of the report is devoted to the description of the experimental analysis of stresses in impeller wheels. It covers a representation of the preliminary design of the model, the materials of which the models were made, the testing equipment, and the initial test results. Author

N63-16532 Royal Netherlands Aircraft Factories Fokker, Amsterdam
THE USE OF OPERATIONAL FATIGUEMETER DATA
J. P. Moulijn [1962] 10 p Presented at the fifth European Aeronautical Cong. Venice, Sept. 1–15, 1962

Fatiguemeter readings obtained with the Fokker Friendship, operated in various parts of the world, are discussed. Special attention is paid to the relation between load factor and stress in the wings, which may vary appreciably as a result of differences in operational use of various airplanes. Important parameters controlling the relationship are take-off weight and fuel weight at take-off. Statistical information on these parameters is presented, and the way in which this information could be used in order to arrive at a representative stress-load factor relation is discussed. Author

N63-16562 Michigan U. Coll. of Engineering, Ann Arbor
SCREENING PROGRAM ON SUPERALLOYS FOR TRISONIC TRANSPORT: INFLUENCE OF NOTCH ACUITY ON THE NOTCH STRENGTH OF RENÉ 41, WASPALOY, AND D979 Report No. 4
J. W. Schultz, T. M. Cullen, and J. W. Freeman Mar. 1963 23 p 3 refs
(NASA Grant NsG-124-61; ORA Proj. 04368)
(Rept. 04368-7-T; NASA-CR-50178) OTS: $2.60 ph, $0.89 mf

René 41, Waspaloy, and D979 alloys were subjected to a testing program designed to evaluate the influence of notch acuity on notch strength. Longitudinal and transverse cold-reduced, aged specimens were tested at room temperature, 650°, 800°, and 1000° F. Notch–tensile strength ratios were found to increase slightly with increasing stress concentration factor to about K_t = 2.1 for all the alloys when tested in the transverse direction.

Longitudinal specimens of René 41 and Waspaloy at all test temperatures and D979 at room temperature also exhibited a slight increase in notch–tensile strength ratio at low values of K_t; at elevated temperatures, D979 showed a rapidly decreasing notch–tensile strength ratio with increasing values of K_t above 1.0. René 41 displayed a steady drop in notch strength with increasing notch acuity beyond low values of K_t. Waspaloy exhibited a similar behavior at room temperature, but at elevated temperatures showed an increasing tendency toward a minimum in the curve of notch–tensile strength ratio vs. K_t in the vicinity of $K_t = 9.4$. D979 alloy also showed a minimum at all temperatures except 650° F. M.P.G.

N63-16578 Minnesota U., Minneapolis
THERMOELASTIC DAMPING [Summary Report, June 15, 1959-Sept. 1961]
L. E. Goodman, C. S. Chang, and A. R. Robinson Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Dec. 1962 36 p 7 refs
(Contract AF 33(657)-7453)
(ASD-TDR-62-1031)

The nonlinear coupled field equations of thermoelasticity are herein solved for the quasi-static behavior of a solid bounded by two parallel planes. The mechanical energy converted to heat during each cycle of the loading process is explicitly evaluated and its spectral variation computed. From this exact solution an approximate, but quite general, expression for the thermoelastic energy dissipated in solids as a result of elastic deformation is developed. Author

N63-16604 Southwest Research Inst., San Antonio, Tex.
SOME PROBLEMS INVOLVED IN TESTING MATERIALS AT HIGH STRAIN RATES
Ulric S. Lindholm *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 14–42 29 refs (See N63-16603 14-34)

A brief review of two typical dynamic testing methods is given. Emphasis is given to methods which yield both instantaneous stress and strain data. The results, in terms of stress vs. strain and stress vs. strain rate, of several investigators are presented. Author

N63-16606 Detroit Arsenal, Center Line, Mich.
STUDY OF SHOCK AND VIBRATION EFFECTS ON VEHICLES THROUGH DYNAMIC STIMULATIONS
F. Pradko, S. Heal, and V. Kowachek *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 81–106 8 refs (See N63-16603 14-34)

This paper introduces a series of integrated research programs concerned with analytical and experimental investigation of vehicle reactions to impact forces. The program presents: (1) equations of vehicle dynamics, (2) techniques for generating random terrain profiles, (3) a unique motion simulator and (4) a "three screen" visual-display system. The simulator described is a high-amplitude device that is capable of producing random motions of bounce, pitch, roll, and yaw. Author

N63-16612 Springfield Armory, Mass.
DETERMINATION OF YIELD STRENGTHS OF ENGINEERING MATERIALS AT HIGH LOADING RATES
Earl H. Abbe *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 242–257 (See N63-16603 14-34)

An apparatus to determine the dynamic yield strength of materials at different loading rates is described. Preliminary results obtained with this apparatus on 4340 steel, quenched and tempered at 140,000 psi tensile strength, are compared to other results with the same material. The apparatus, modified to eliminate end clamping effects, consists of a circular plate mounted on three short columns, and a central piston. The specimen (a hollow cylinder approximately 4 inches long) is threaded into the bottom of the circular plate in line with the piston. The lower end of the cylinder is threaded into a thick hollow sealing chamber cylinder with an instrumented plunger inserted into its lower end. The end of the plunger rests on the base plate which supports the entire fixture. The specimen is filled with fluid, and the force from the piston, when struck by a falling weight, is transmitted through the fluid to the specimen. The instrumentation consists of two oscilloscopes, a piezoelectric pressure gage and amplifier, and two strain gages. Although useful engineering data have not been obtained as yet, the reliability of the techniques used for dynamic testing of engineering materials is being evaluated, and a method of producing various strain rates has been developed. M.P.G.

N63-16613 Feltman Research Labs., Picatinny Arsenal., Dover, N.J.
EXPLOSIVE DEFORMATION OF BEAMS
E. N. Clark, F. H. Schmitt, and D. G. Ellington *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 258–289 5 refs (See N63-16603 14-34)

Experiments which determine the central deflection versus time of rigidly clamped and free rectangular beams of constant cross section have been performed. Beams of 6061 T6 Al, 20240 Al and a soft 1010 steel were placed on supports approximately ten inches apart and centrally loaded with a sheet of high explosive. The central deflection of these beams was observed with a framing and streak camera. Representative graphs are included. The high explosive (trade name EL 506 D) was calibrated by measuring the velocity imparted to a known mass of aluminum which was covered by an effectively "infinite" but known amount of HE. It was determined that the HE delivered 18.60 (10^4) dyne per gm of HE through a .055-inch-thick sheet of polyethylene. Author

N63-16614 Watervliet Arsenal, N.Y.
THERMAL STRESSES ARISING IN GUN TUBES DURING REPETITIVE FIRING
L. G. Mielke and T. F. Mac Laughlin *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 290–303 8 refs (See N63-16603 14-34)

Two experimental methods, which are being used to determine the thermal stresses set up in smooth bore gun tubes during repetitive firing are presented, together with the theoretical considerations on which the methods are based. One method uses a photothermoelastic approach; two polariscopes are positioned along the tube such that one obtains fringe patterns of stress differences in radial and tangential directions and the other obtains fringe patterns of stress changes in radial and axial directions. Equations are presented for evaluating the corresponding stress in the entire tube. The other method uses a thermal-electric analogy technique by which the stresses in circumferential sectional subdivisions of the tube are deduced from resistance changes reflecting temperature changes in each subdivision. Preliminary photoelastic results are being compared to theoretical solutions for the heat transfer in cylindrical tubes, and, if a correlation is found, the photothermoelastic method will be extended to the experimental analysis of rifled tubes. M.P.G.

N63-16616 Watervliet Arsenal, N.Y.
A METHOD FOR RAPID DYNAMIC EVALUATION OF LARGE WEAPON COMPONENTS
T. F. Mac Laughlin and J. P. Purtell *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 315–327 3 refs (See N63-16603 14-34)

A description is given of a high-energy impact machine which closely simulates the firing of large weapons, and is used to dynamically evaluate a variety of weapon components. Dynamic stress analyses and fatigue-life data are obtained by simulated firings at a rate of 100 per minute, making economically possible realistic life estimates. Problems in simulation and instrumentation are also discussed. Author

N63-16621 Columbia U., New York, N.Y.
DYNAMIC BEHAVIOR OF ROCKS UNDER CONFINING PRESSURE
Fred A. Donath *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 416–437 10 refs (See N63-16603 14-34)

Permanent deformation in rock results from the action of differential stress and may be expressed as fracture, flow, or a combination of the two. The strength and ductility of rock change markedly under the influence of confining pressure. The ultimate strength of a rock may increase several hundred to several thousand percent with increasing confining pressure; for many rocks, this increase appears to be nearly linear. Similarly, the ductility increases appreciably with increased confining pressure for most common rocks. The increase in ductility is commonly accompanied by a change in mode of deformation from fracture to flow. Temperature and strain rate also greatly influence the strength and ductility of rock. The presence of planar anisotropy may have a marked effect on both the breaking strength and the angle of shear fracture in rock. Author

N63-16623 Aberdeen Proving Ground. Ballistic Research Labs., Md.
RESPONSE OF CYLINDRICAL SHELLS EXPOSED TO EXTERNAL BLAST LOADING
William J. Schuman, Jr. *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 454–468 6 refs (See N63-16603 14-34)

A method of predicting permanent deformation of thin-walled, unstiffened, cylindrical shells exposed to external blast loading from charges of high explosive is presented. Empirical relations are derived from a series of firings conducted primarily at the Aberdeen Proving Ground, against scaled shells. The average deviation between predicted and actual pressures is 6%. Author

N63-16624 Frankford Arsenal, Philadelphia, Pa.
PHOTOELASTIC STUDIES OF DYNAMIC STRESSES IN LOW MODULUS MATERIALS
P. D. Flynn, J. T. Gilbert, and A. A. Roll *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 469–494 13 refs (See N63-16603 14-34)

In 1960, the Frankford Arsenal began a program in dynamic photoelasticity using low-modulus materials subjected to either mechanical or explosive loads. High-speed photographic techniques were used to obtain full-image dynamic stress patterns at approximately 7500 pictures per second and exposures of 1.3 μsec. Recently, a dual-polariscope was designed for obtaining simultaneous views of a specimen at normal and oblique incidence. This paper reviews the techniques developed for this work, discusses the results of fundamental studies on stress distributions under dynamic conditions, and outlines future plans. Author

N63-16625 Army Engineer Research and Development Labs., Fort Belvoir, Va.
A PROPOSED METHOD FOR THE STUDY OF THE DYNAMIC STRENGTH OF HIGH STRENGTH MATERIALS
Francis B. Paca *In* Army Research Office Proc. of the Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 495–505 5 refs (See N63-16603 14-34)

Serious problems arise when several types of different materials of very high strength are to be evaluated for dynamic response to short loads (i.e., a few microseconds). Under these conditions, much of the current equipment cannot produce or accommodate one or more of the following: the short loading time, the mismatch of mechanical impedance, or the propagation of a stress wave of the required intensity. A method is proposed by which many of the above limitations can be overcome. In this method, the samples of the material under study are formed into flat-ended cylinders and subjected to guided impact against a massive, high-strength target block. The stress is calculated from impact velocity and the mechanical impedance of the sample, $\sigma = V_0/(C_\rho)$. The loading time is a function of the length of the sample and the elastic wave velocity. Test samples of a given length are fired (one time per sample) with increased velocity until failure occurs at the forward or impacting end. This determines V, or stress. Author

N63-16677 General Dynamics/Fort Worth. Nuclear Aerospace Research Facility, Tex.
MEASURED EFFECTS OF THE VARIOUS COMBINATIONS OF NUCLEAR RADIATION, VACUUM, AND CRYOTEMPERATURES ON ENGINEERING MATERIALS Quarterly Progress Report, Nov. 9, 1962-Feb. 28, 1963
E. E. Kerlin and E. T. Smith Mar. 15, 1963 97 p 21 refs (NASA Contract NAS8-2450(Mod.3))
(FZK-163; NASA-CR-50020) OTS: $8.60 ph, $3.11 mf

The objectives of this program are to study the combined effects of radiation and vacuum, the combined effects of radiation and cryotemperature, and the combined effects of radiation, vacuum, and cryotemperature on the component parts of nuclear-powered spacecraft. Progress to date is as follows: (1) the decontamination, repair, and modification of the experimental equipment; (2) the selection and ordering of test materials, such as structural adhesives, structural laminates, potting compounds, electrical insulation, seals, dielectric materials, thermal insulations, and lubricants; (3) the design of a thermal conductivity tester; and (4) a test plan for the year's work. I.v.L.

N63-16690 Armour Research Foundation, Chicago, Ill.
RESEARCH ON THE BASIC NATURE OF STRESS CORROSION FOR VARIOUS STRUCTURAL ALLOYS AT ROOM AND ELEVATED TEMPERATURES [Final Report, Dec. 15, 1961-Feb. 16, 1963]
Frank A. Crossley et al Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Feb. 1963 56 p 9 refs For Part I see N63-15494 12-18)
(Contract AF 33(616)-7612)
(ASD-TR-61-713, Pt. II; ARF-B206-12)

It was hypothesized that poor resistance to stress corrosion of high-strength, wrought aluminum alloys was due to the layered type microstructure characteristic of these materials.

Phases which are out of solid solution in the original as-cast structure tend to be concentrated in the grain boundaries. During working, the original grains are flattened out into plates and, therefore, the second-phase particles are distributed in layers. During the solution heat treatment, the recrystallized grains grow until the growth is inhibited by these second-phase particles. As a consequence, the wrought, heat-treated product has planes of weakness parallel to the major direction of working. Commercial 7075-T6 and materials of the same composition prepared in the laboratory in the form of 1-in. plate were compared as to susceptibility to stress corrosion in the short-transverse direction. In these materials, short life was associated with the layered type of grain structure characteristic of commercial material, and long life was associated with irregular or equiaxed grain structures. The experimental results gave good support to the hypothesis. Apparatus was set up to measure elevated-temperature crack growth kinetics by monitoring resistance with a precision Kelvin bridge. Author

N63-16694 Brown U. Div. of Engineering, Providence, R. I.
EXPERIMENTAL AND THEORETICAL STUDY OF WAVE PROPAGATION AND VIBRATION PROBLEMS Final Report
J. Duffy and C. Mylonas May 1963 6 p 6 refs
(Contract DA-31-124-ARO(D)-37)
(AROD-2571-3)

The development of a birefringent coating technique and the construction of a high-speed camera and light source to be used in conjunction with the coating are reviewed in the light of studying the deformation of structures, whether they be made of metal or other material, when subjected to dynamic loading that may cause permanent deformations. This technique should permit the observation of waves progressing throughout a structure, whether these waves be elastic or plastic. I.v.L.

N63-16740 Midwest Research Inst., Kansas City, Mo.
STUDY OF ULTRASONIC TECHNIQUES FOR THE NONDESTRUCTIVE MEASUREMENT OF RESIDUAL STRESS [Final Report, Feb. 1, 1962–Jan. 31, 1963]
Fred R. Rollins, Jr., and Peter Waldow Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, May 1963 47 p 5 refs
(Contract AF 33(616)-7058)
(WADD-TR-61-42, Pt. III)

The theoretical and experimental investigation of ultrasonic beam interaction in solid materials has been continued. Interaction of pulsed beams (3 to 15 mc/s) under "resonant" conditions reveals that interaction does occur in many materials. A theoretically predicted third beam is generated at the "point" of intersection and has been experimentally observed in samples of fused silica, polycrystalline aluminum, and polycrystalline magnesium. A potential method of three-dimensional stress analysis is discussed. An optical system for studying beam interaction in transparent solids is also described. Author

N63-16751 Mitron Research and Development Corp., Waltham, Mass.
DERIVATION OF SHOCK AND VIBRATION TESTS BASED ON MEASURED ENVIRONMENTS
M. Gertel *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1–4, 1962 Mar. 1963 p 25–33 8 refs
(See N63-16750 14-01)

Problems pertinent to simulating the damaging effects of shock and vibration environments are presented. The two diametrically opposed approaches to the problem of shock and vibration simulation pursued by the S2-X-46 committee of the American Standards Association are outlined. These approaches are: (1) the exact duplication of the environment and (2) simulation of the damaging characteristics embodied in the environment. D.E.R.

N63-16784 Battelle Memorial Inst., Columbus, Ohio
INITIAL IRRADIATION EVALUATION OF EXPERIMENTAL PYROLYTIC-CARBON-COATED UC_2 AND UO_2 FUEL PARTICLES
Richard J. Burian, Neil E. Miller, Robert L. Ritzman, and Charles W. Townley Apr. 25, 1963 25 p 6 refs
(Contract W-7405-eng-92)
(BMI-1628) OTS: $0.50

Static and sweep irradiation capsules were used to evaluate the in-pile performance of experimental pyrolytic-carbon-coated UC_2 and UO_2 particles at temperatures ranging from 100° to 1070° C. Failure of the coatings occurred in all cases where average coating thicknesses were less than about 70μ. At 100° C, this failure was very rapid, occurring after about 6 hr of irradiation in the case of UC_2 particles with a 57μ columnar pyrolytic-carbon coating. At elevated temperatures, failure did not begin until after about 5 to 10 days of irradiation and appeared to be associated with temperature changes caused by reactor shutdowns and start-ups. Coating failure at low temperature did not occur in the case of particles with thick (greater than about 110μ) columnar or laminar pyrolytic-carbon coatings and with thick (greater than about 90μ) coatings containing layers of porous pyrolytic carbon. Author

N63-16880 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
PRELIMINARY INVESTIGATION OF CATASTROPHIC FRACTURE OF LIQUID-FILLED TANKS IMPACTED BY HIGH-VELOCITY PARTICLES
Francis S. Stepka and C. Robert Morse Washington, NASA May 1963 29 p 9 refs
(NASA TN-D-1537) OTS: $0.75

Metal test specimens, acting as a wall of a liquid-filled tank, were impacted by small, high-speed particles. The specimens were 1/32- and 1/16-inch-thick 2014-T6 and 7075-T6 aluminum and 1/32-inch-thick 60-percent-cold-reduced AISI 301 stainless steel. The liquids used were water, glycerin, and nitrogen. The impacts were made at velocities up to 7500 feet per second. The investigation showed that catastrophic fracturing rather than simple puncturing can occur as a result of impact. The importance of some of the primary variables contributing to the fracturing is discussed. Author

N63-16971 Illinois U., Urbana
AUTOMATIC AREA COMPENSATOR FOR CONSTANT STRESS-CYCLING
C. E. Feltner and J. A. Jackobs May 1963 12 p refs
(Contract AF 33(616)-8177)
(T&AM-247)

An automatic area compensator device is described for constant stress-cycling machines. The adaptability of this device to other tensile testing or fatigue machines will depend on specific circuit designs. In general, the device cannot be inserted (1) inside a feedback loop, (2) after a circuit that precedes a very high impedance circuit, or (3) before a circuit with a low input impedance. D.E.R.

34 STRUCTURAL DESIGN

Includes: structural elements; and weight analysis.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 33 Stresses and Loads.

N63-16438 Air Force Cambridge Research Labs. Electronics Research Directorate, Bedford, Mass.

ENVIRONMENT SENSING– A NEW APPROACH TO THE DESIGN OF AN ELECTRONIC AID FOR THE BLIND Research Note

Walton B. Bishop Mar. 1963 33 p 8 refs (AFCRL-63-64)

Environment sensing is defined as the collecting of sufficient information, in useable form, concerning one's environment to permit safe mobility. Primary emphasis is placed upon the design of a device suitable for use by the blind. Two devices are described: one accepts light approaching over a very small solid angle, the other accepts light over a reasonably large but adjustable solid angle. The geometrical problems associated with the use of these sensors are discussed in some detail. Environment sensing is described in terms of eleven simple problems suitable for a theoretical mechanical man (machine) to solve. A blind human being should be able to solve at least these eleven problems if provided with a suitable transducer for relaying the information to his brain. A transducer using the sense of touch is suggested as being most desirable. Both the sensing device and the transducer appear to be physically realizable with solid-state electronic circuitry. Author

N63-16577 Army Corps of Engineers. Engineering Div., Jacksonville, Fla.

MISSILE LAUNCHING FACILITIES AT CAPE CANAVERAL

Joe J. Koperski Gainesville (Fla. U. Eng. and Ind. Exptl. Sta.) Feb. 1963 Repr. from Eng. Progr. at Fla. U., Vol. XVII, No. 2; Proc. of the 1962 Fla. Highway Eng. Conf., Nov. 15-16 1962 Bull. Ser. 112 p 21-24

Planning, design, and construction of missile and rocket launching facilities at Cape Canaveral are discussed. A review of facilities improvements with concurrent improvement in rocketry for the expanding space effort are presented. Major emphasis is devoted to the developmental construction of pavement installations such as roads, parking facilities, runways, causeways, bridges, buildings, and launching pads in the Cape Canaveral area. N.E.A.

N63-16603 Army Research Office, Durham, N.C.

PROCEEDINGS OF THE ARMY CONFERENCE ON DYNAMIC BEHAVIOR OF MATERIALS AND STRUCTURES HELD AT SPRINGFIELD ARMORY, SPRINGFIELD, MASSACHUSETTS, 26-28 SEPTEMBER 1962

Nils M. Bengtson [1962] 565 p 151 refs Report includes Abstract Supplements of Symp. on Structural Dyn. under High Impulse Loading, Dayton, Ohio, Sept. 17–18, 1962, and Symp. on Dyn. Behavior of Mater., Albuquerque, N. Mex., Sept. 27–28, 1962

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N63-16610 Battelle Memorial Inst., Columbus, Ohio
THE DYNAMIC BEHAVIOR OF HYPERCRITICAL-SPEED SHAFTS
John E. Voorhees, C. C. Mellor, Jr., and R. G. Dubensky *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26–28, 1962 [1962] p 150–169 (See N63-16603 14-34)

The dynamic behavior of VTOL and STOL power transmission shafts that operate above their critical speeds was investigated. The experiments showed that, with one or two dampers strategically located along the shafts, hypercritical operation of the shafts is practical and offers significant weight-reduction advantages. An electrical analogy was used to develop a systematic procedure for the design of shaft dampers to prohibit excessive and dangerous vibration amplitudes at desired operating speeds. Once a suitable high-speed shaft system has been designed by the electrical analogy procedure, a dynamically similar operation of dissimilar shafts (by adjustments of the damper parameters) can be obtained through the use of modeling equations developed during this program. The research results presented are equally applicable to the design of solid and tubular shafts, but the resulting decrease in weight makes tubing particularly desirable for aircraft applications. Hypercritical-speed shafting is especially attractive because of the possibility of transmitting power at the same high speed at which it is produced, with an associated reduction of engine and gear weight. M.P.G.

N63-16620 Watervliet Arsenal, N.Y.

A NEW CONCEPT FOR STUDYING PRESSURE VESSEL CONFIGURATIONS UNDER HIGH PRESSURES AND LOADING RATES

T. E. Davidson and D. P. Kendall *In* Army Research Office Proc. of the Army Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26-28, 1962 [1962] p 396-410 3 refs (See N63-16603 14-34)

This paper discusses the design and operation of a newly developed testing system for hydrodynamically producing pressures up to 50,000 psi in full-scale pressure-vessel configurations. Rise times of 3 milliseconds can be obtained in large vessels and considerably shorter rise times are possible in smaller vessels. Two existing systems are described, and an analytical method of determining the pressure-time response for any similar system is presented. Several experimental pressure-time curves are shown and compared with the computed curves. The possibility of using such a system as a basis for a high-strain-rate tensile-testing machine is discussed. Author

N63-16626 Army Missile Command. Structures and Mechanics Lab., Redstone Arsenal, Ala.

STRUCTURAL RESPONSE TO MISSILE THRUST

J. N. Crenshaw *In* Army Research Office Proc. of the Conf. on Dyn. Behavior of Mater. and Structures held at Springfield Armory, Mass., Sept. 26-28, 1962 [1962] p 506-515 (See N63-16603 14-34)

A mathematical mass-spring model is developed for determining dynamic load factor values for use in missile design. The shock experienced by the missile structure as a result of thrust at ignition is expressed as a forcing function on a single-mass spring model. The ratio of a natural frequency of the spring mass to the frequency of the forcing function is used as a parameter to define the response of the vehicle in terms of a multiple of the instantaneously impressed force. The dynamic load factor values obtained using this model were found to agree favorably with test results for a given test model. Further effort is necessary to establish additional test measurement procedures and to clarify the relationship of the actual structural mass distribution to the forces that are generated as a result of motion. M.P.G.

N63-16764 Ling-Temco-Vought, Inc. Research Center, Anaheim, Calif.

HIGH INTENSITY SONIC TESTING— A TOOL FOR THE STRUCTURAL ANALYST

J. J. Van Houten *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1-4, 1962 Mar. 1963 p 181-188 2 refs (See N63-16750 14-01)

Experimental evaluation of structural elements is the paramount factor in predicting the integrity of flight-vehicle performance with respect to acoustically induced fatigue. Accurate prediction requires evaluation of the structural response, damping characteristics, system nonlinearities, and a random fatigue test. A test technique is described which permits this evaluation to be performed in one versatile testing unit. Author

N63-16768 Aeronautical Systems Div., Air Force Systems Command, Wright-Patterson AFB, Ohio

EFFECTS OF WEIGHT ON THE FREQUENCY AND AMPLITUDE OF VIBRATION TEST ITEMS

C. E. Thomas and P. G. Bolds *In* Defense Dept. Office of the Director of Defense Research and Engineering, Washington, D.C. [Papers from] 31st Symp. on Shock, Vibration and Assoc. Environments—Part II, Phoenix, Ariz., Oct. 1-4, 1962 Mar. 1963 p 216-223 This paper was not presented at Symp. (See N63-16750 14-01)

Presented in this paper are the results of a survey which was made to investigate the effects of weights, in an in-flight vibration environment, on the dynamic characteristics of equipment. Author

N63-16820 Vickers-Armstrongs Aircraft, Ltd., South Marston (Gt. Brit.)

CONSIDERATION OF AIR TURBULENCE IN AIRCRAFT DESIGN

G. F. H. Hemsley *In* Royal Aircraft Establishment, Farnborough (Gt. Brit.) Atmospheric Turbulence and its Relation to Aircraft. Proc. of a Symp. held at R.A.E., Farnborough, Nov. 16, 1961 1963 p 173-193 (See N63-16812 14-01) HMSO: £1 10s

The effects of turbulence on the design of civil aircraft are discussed, indicating where design is critical to atmospheric conditions. Laboratory testing of equipment under simulated environmental conditions is necessary to prove reliability. Examples are given where local atmospheric conditions can influence the design. Some conclusions as to the effect of turbulence on a Supersonic Transport are given. Military aircraft are being designed to operate for long periods under high-speed low-altitude conditions. The design problems of achieving a satisfactory standard of crew comfort are discussed. Author

N63-16938 Republic Aviation Corp., Missile Systems Div., Mineola, N.Y.

EVALUATION OF HIGH-STRENGTH LIGHTWEIGHT LAMINATED PRESSURE VESSELS OF LAP-JOINT CONSTRUCTION Fourth Quarterly Progress Report, 1 Oct. to 31 Dec. 1962

G. Citrin Watertown, Mass., Watertown Arsenal Labs., Jan. 16, 1963 23 p

(Contract DA-30-069-ORD-3440)

(RAC-1160; WAL-TR-766.2/3-3)

During this quarter, the production sheet-metal material has been delivered and evaluated against specification requirements. Rings were fabricated of the 0.021-inch-thick mar-aging steel material for the first three pressure vessels. The first pressure vessel was assembled and tested successfully, producing a burst strength 7.9 percent greater than that indicated by uniaxial tensile tests of the parent sheet metal. Author

N63-16963 Gt. Brit. Ministry of Aviation. Technical Information and Library Services, Mottingham

PROBLEM OF AIR-COOLING GAS TURBINE BLADES (K VOPROSU O VOZDUSHNOM OKHLAZHDEN II LOPATOK GASOVYKH TURBIN)

A. G. Zenukov Apr. 1963 12 p 5 refs Transl. into ENGLISH from Vyssh. Zavedenii. Aviats. Tekh. (Kazan), (2), 1962 p 130–137 (TIL/T-5374)

This report describes a design of blade in which the profiled "cover" surface surrounds, but is not rigidly secured to, a central supporting stem which is integral with the blade root. The external cover is free to expand. All the stresses on the blade assembly are taken by the "cold" stem. Cooling air passes from the blade root, between the stem and cover shell. Author

N63-16970 Illinois U., Urbana

AN ANALYSIS OF THE TORSIONAL RIGIDITY OF AN INTERMITTENTLY STIFFENED I BEAM

D. F. Adams (Ph. D. Thesis) May 1963 57 p 22 refs (TEAM-246)

A thin-walled I cross section is considered, stiffener plates of arbitrary length being attached across the edges of the flanges at intervals to form closed sections. This intermittently stiffened I beam is analyzed as a member made up of open and closed sections joined together. The externally applied torque is assumed to be resisted at each cross section by a combination of pure torsional (St. Venant) shearing stresses and shearing forces associated with lateral bending. The lateral bending is a result of the difference in the warping characteristics of the open and the closed cross sections. Differential equations of equilibrium are derived for each section and then solved to obtain expressions for the angle-of-twist per unit length. The necessary boundary conditions are established in order to evaluate the constants in these expressions. Author

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